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ABSTRACT

FARM DEPOPULATION AND ITS ASSOCIATIONS WITH CHANGES IN THE COMPONENTS OF AGRICULTURAL SYSTEMS AND RESOURCES; A GEOGRAPHICAL STUDY OF THE NORTHERN APPALACHIANS IN THE TWENTIETH CENTURY

By

Warren Douglas Slocum

Farm depopulation, an old but ever present phenomenon in the United States, has not received the research attention that it deserves, given the serious implications its continuance will have on the welfare of the United States. Farm depopulation, the dependent variable in this study, is equal to the county farm population percentage remaining from a prior census count at the end of each one of the study's time periods, 1910-1930, 1940-1950, 1950-1960, and 1960-1970.

In this dissertation, the areal patterns of depopulation in the northern part of a well-known region of the United States, the Appalachians, are analyzed as to their temporal and areal relationships with the agricultural geography and agricultural systems of the Region. Agricultural subsystems and their attributes, i.e., agricultural variables, are perceived as the recipients of stimuli from exogenous technological forces and consequently serve in varying degrees as indicators of the importance of outside inputs (resources)

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to agricultural systems and subsystems. Twenty-one agricultural variables reflect those characteristics of agriculture hypothesized as most likely to be changed by technological forces. The natural and geographical setting of an agricultural system influences the ultimate effect of technological forces on parts of an agricultural system.

To gain independence among the variables and a general description of farming, the agricultural variables are grouped by principal component analyses for each time period. Through the interpretation of the variable loadings, the principal components--the major "dimensions" of agriculture for the study area--are obtained and these are mapped for areal analysis. These components represent the subsystems, e.g., mechanization, capital investment, off farm inputs, labor, land, or type of farming most important in an area.

The next stage of analysis applies to a series of stepwise multiple regressions with the components serving as "truly" independent variables and the farm population retention percentages as the dependent variable. Farm depopulation and retention rates are associated in varying degrees with each component.

In the first two time periods farm depopulation is found to be only slightly related to the agricultural components. In the time periods following World War II, the farm depopulation is associated significantly and collectively with several agricultural components. The agricultural components of 1949-50 account for 82.6 percent of the farm depopulation variance in the 1950s. The agricultural components of 1969-70 account for 73.3 percent of the farm depopulation variance in the 1960s. Off farm employment is most closely associated with farm popu

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farm population losses; whereas dairying is most nearly related to farm population retention. Farm population decreases of the northern Appalachians are now associated with agricultural characteristics under the forces of both the technological system and the geographical setting.

FARM DEPOPULATION AND ITS ASSOCIATIONS WITH CHANGES IN THE COMPONENTS OF AGRICULTURAL SYSTEMS AND RESOURCES; A GEOGRAPHICAL STUDY OF THE NORTHERN APPALACHIANS IN THE TWENTIETH CENTURY

By

Warren Douglas Slocum

A DISSERTATION

Submitted to
Michigan State University
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Department of Geography

1976

In Memory
of my father, Bernard E. Slocum,
who respected a college education,
but never had the opportunity to
obtain a high school education.

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ACKNOWLEDGMENTS

Advancement through graduate school probably requires most of all steadfastness from the candidate and patience from those individuals closely associated with him. Frequently, the following is stated: "One obtains from college what he or she is willing to put into it." There is considerable truth in this statement, but in reality no human being is a world to himself in motivation, knowledge, assurance, financial resources, skills, faith, or whatever. This candidate is indebted to many persons: academicians, relatives, friends, neighbors, and public servants for their advice, guidance, shared ideas, and encouragement.

I am grateful for the opportunities granted to me by several academic institutions, not all of which can be named. The excellent foundational education in geography, I obtained from the Pennsylvania State University in the late 1960s has proven extremely valuable in my doctoral program and subsequent work. Study at Michigan State University in the early 1970s has widened my perspectives and perceptions. Dr. Georg Borgstrom, my major professor throughout my doctoral studies, has kindly and patiently given of his valuable time and ideas, and has provided encouragement at the most appropriate times. The Department of Geography provided financial assistance, research and teaching experience during a transitional time in my life.

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Valuable experience in field study and insight into rural people's values, needs, and perceptions were acquired in the Ontonagon County, Michigan project while employed as a research aid by the College of Human Ecology. Dr. Margaret Bubolz and Dr. Joanne Eicher through discussions on the Ontonagon study unwittingly contributed to the writer's evolving dissertation research.

To my relatives and family, my wife Ann, daughters Maria and Andrea, my mother, and "grandparents," I express my appreciation for their continued forbearance, work, and support.

Friends and students of the University community provided at certain critical times invaluable assistance and advice in computer science, statistics, and cartography. Sherman Hollander, Mike Lipsey, and Mark Walters provided much appreciated cartographic and drafting skills. To all the typists, including my wife and mother-in-law, I give my sincere thanks.

Finally, recognition and words of gratitude are expressed to the Michigan Department of Natural Resources (DNR), Bureau of Environmental Protection and staff for employment that has given to me both the necessary desire and the financial resources to complete this degree's final requirements. My writing skills since the completion of most of this dissertation have been hopefully improved through the writing of a final report that the DNR will submit to the United States Environmental Protection Agency.

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CHAPTER 1

INTRODUCTION: A THEMATIC AND CONCEPTUAL ORIENTATION

The Setting in Population Issues

Among the major issues and concerns of the times are overpopulation and the interrelated and concomitant problems: famine, pollution of the environment, energy shortages, and depletion of the earth's finite resources. No similar level of awareness exists for the serious problem of depopulation. In the United States many rural areas have sustained large population losses and have sent, and continue to send, people to urban and metropolitan areas. The investigation of the causes of rural population decreases have been inadequate. In a market economy where jobs are frequently lost in the countryside due to the adoption of innovations and acceptance of technological changes, the net movement of human resources out of rural areas often sentences the remaining rural population to difficult social and economic readjustments and subjects such areas of depopulation to many years of exploitation, economic dependence, and social stagnation.

The depopulation of rural areas in the United States (Figure 1) has come about primarily through outmigration and secondarily through growing natural decrease (Beale, 1964; 1969). Natural decrease occurs when deaths exceed births--traditionally, a rare condition reached

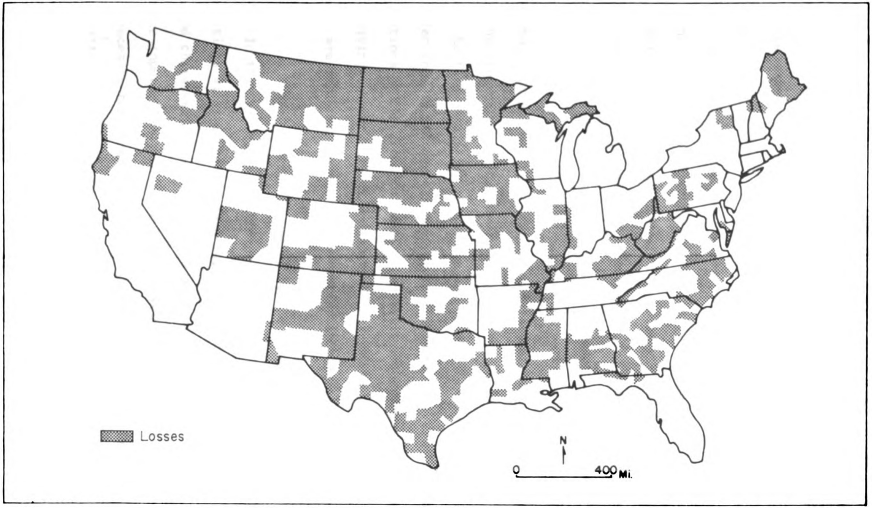

Fig. 1.--Main Areas of Population Losses, 1960 to 1970.

ordinarily after much outmigration. As people of reproductive ages generally compose the larger proportion of the outmigrants, the median age and dependency ratio of the source population significantly increase.

A knowledge of the reasons for population changes is basic to the planning of a healthy economy and society. To successfully treat an illness, one needs to define well the primary causes. The treatment of causes is preferred to the treatment of symptoms in a long run strategy for problem solving. The complex depopulation phenomenon appears to have numerous causes, and is thus relatively poorly researched. To reach more meaningful results, a population, because of its heterogeneity, needs to be disaggregated. This writer has chosen the farm population as the subject of study because of the major declines in its numbers over several decades. Particularly the associations of the areal patterns of agricultural depopulation with the evolving characteristics and spatial patterns of agricultural systems are explored and analyzed over time in this dissertation.

General Statement of the Problem

In this effort of explaining agricultural depopulation, associations will be made of farm population losses with changes in selected characteristics of agricultural systems, i.e., mechanization, resource inputs, land use, labor, and production, and with notable differences in the environmental and socioeconomic conditions. Empirically, it is quite evident in many rural areas of the United States that agriculture and country life have deteriorated catastrophically. To be answered in this research is to what extent changes in the agricultural geography account for the historical and spatial agricultural depopulation in the study area. The areal patterns of the farm population declines are anticipated to give clues to the causes of and suggest more specific hypotheses for the major farm population losses.

Due to the adoption of new technology and increasing amounts of new and substituted inputs, e.g., capital, feed grains, and fertilizer, obtained primarily off the farm, significant changes have occurred in the functioning of the agricultural systems of some regions. Some practices of the "new agriculture" are in general ecologically and sociologically unsound, and developments and the evidence support this view (Milk, 1972, pp. 233-234). Little emphasis and attention have been placed on the negative social and economic consequences of the "new agriculture" upon the conditions and welfare of the agricultural population. Needed is more awareness that new innovations may be used sometimes ineffectively and destructively in both an environmental and sociological sense in areas not possessing the optimal site and situational characteristics, and socioeconomic conditions for their successful implementation.

Ecological assessments of agricultural systems for underdeveloped areas are crucially needed both overseas and at home but such are easily neglected where there exists the immediate need to increase food production. Elements of some agricultural systems have clearly debilitating effects on physical and human resources. By studying how the agricultural systems have evolved and functioned in different time periods and selected areas within a region of a devel

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developed nation, the writer anticipates that the findings of a case study may provide some evidence of the adverse consequences of complete acceptance of new agricultural technology. Some findings may be applicable to the developing world, now faced with massive rural-urban migration, unemployment, urban hunger and general malnutrition. A few guidelines to successful rural development may evolve. Realistic assessments of agricultural technologies and systems' limitations in varying physical and cultural areas and regions of the world are essential to human welfare.

Thesis and Significance of Technology in the Explanation

Does the degree of farm depopulation in an area or region differ according to the nature of the prevailing agricultural systems and the changing agricultural geography? Agricultural systems are of course subsystems of a culture, and therefore, are affected by the technological changes within that culture. Examples of rural depopulation come from developing and industrialized countries and capitalistic and socialistic nations (Council of Europe, Vol. 1, 1968, p. 1) thus, there appears to be a variety of causes, some that are culture-specific. Some caution needs to be taken in generalizing from one culture. Each population possesses and belongs to a culture; therefore, it is really not presumptuous to assume that within this "elaborate mechanism" (White, 1949, p. 166) or large system may be the major factors underlying the depopulation process. One of the most pervasive aspects of the United States culture has been technological change. Technological developments have vastly altered the charact

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character of Western agriculture, the agrarian society, and the self concepts of many unemployed and underemployed persons who may feel superfluous.

Culture is a system composed of technological, sociological, and ideological subsystems. Naturally each is related to the other, but the strengths of these relationships is not equal. The major influence is effected by the technological system. This is so because man's survival, and ultimately culture itself, depends upon the means at hand to obtain the necessities of life from the environment. "The technological system is therefore both primary and basic in importance; all human life and culture rest and depend upon it" (White, 1949, pp. 364-365).

With the application of much new technology, i.e., new inputs and mechanization in agriculture, a surplus of agricultural labor eventually developed in the United States. Too many farmers and farm laborers were generally thought to be the basic cause of the troublesome food surpluses and of the low farm incomes in the United States. Large numbers of emigrants in the late 1800s and early 1900s added additional labor; but farmers after World War II experienced difficulty finding farm help. In the United States the earliest demand for more machines and their invention stemmed from the labor shortages resulting from the Mexican War, the California Gold Rush, and the Civil War (Barger and Landsberg, 1942, p. 198); similar events since, e.g., World War I and World War II have generated demands for further development of new agricultural technology and the adoption of labor-saving methods and mechanization. The new technology generally substituted for much farm labor which was particularly scarce during and after wars; and, the strong dependence at these critical times upon the succession of new and "more modern" technical creations and developments to increase production, probably led to an over-acceptance of these "new scientific ways and means" and to the development of "technological overpopulation" (Pinchemel, 1969, p. 114). Thus, human resources were pushed out of agriculture.

The technological capabilities possessed by a people will also dictate the materials or substances that are considered valuable resources (Carol, 1967, p. 285). As the technology changes, different resources are required. Some areas or environments may not possess the resources needed by the updated technology; and thus, new technology is sometimes ill-fitted for some areas and environments. Through additional technology, man changes his socioeconomic organization and usually gains in the aggregate, access to a greater array and different sets of resources, with more impact and control upon the environment; but, sometimes for many areas this latter development may be an illusion when the resources favored and assembled by the new technology are not as available as the set of resources required by the older technology. When the right resources cannot easily be obtained and matched with the new technology (presumably of yet a higher order), an area may be unable to compete successfully in production and trade. Because of rising population such an area may have an abused environment. In an exchange economy, people of such an area are at a disadvantage in producing a good that is produced easily in other places by the new technology. If resources can be obtained economically from without, the new technology may be incorporated into the production process. Because advances in technology generally require a greater range and variety of inputs, the probability of gaining all the needed elements is lowered.

The thesis of this dissertation is that changes in the characteristics of the agricultural systems brought about through the adoption of new technology, at times adversely change the value and usefulness of human, bio-physical, and socioeconomic resources existing in rural areas, and set in motion "push" factors, i.e., conditions, which facilitate the depopulation process. Technology, e.g., innovations, inventions, and new methods alter the agricultural systems and existing mix of inputs through requiring new sets of resources, e.g., labor, level land, well-drained soil, and capital for investment--to name only a few; these inputs sometimes are not present or owned and cannot always be gained or arranged in particular places.

Some Definitions and Operational Measures of Depopulation

The general topic of this research effort, depopulation, regardless of its various types, e.g., rural, agricultural, and central city, or other named for its particular place of occurrence, can be thought of as either a phenomenon or a process and either a condition or a set of conditions. In this study the descriptive and analytical tasks address the spatial patterns and causes of agricultural depopulation, and secondarily, the depopulation process, for at the origin of the depopulation process are the causes.

To solve a problem, e.g., agricultural depopulation, one theoretically needs to know first what it is before attempting to discover how it came to be. Unfortunately, little research is available on the definition of depopulation and when definitions are given they tend to be too restrictive to give a complete concept of and a full measure of depopulation. The failure to delineate depopulation in nearly all the works on the subject indicates its meaning is not agreed upon. Although many personal definitions of depopulation exist, most individuals engaged in a study of depopulation would agree it is the process, accomplished fact, or consequences of population loss from a given area during a given time.

The most complete definition of depopulation this writer has found comes from a British government publication on depopulation in Wales. It states,

> Depopulation is sufficiently defined for our purpose as a substantial continuing decline in population. It is generally the result of net outmigration of sufficient volume to offset any natural increase (excess of births over deaths) of population, but in extreme cases it can result from a combination of natural decrease (excess of deaths over births) of population and net outward migration (Great Britain Ministry, 1964, p. 1).

To this rather recent statement as to what depopulation is, one may add the essence of implicit and explicit meanings from a few older studies. In the late 19th century, rural depopulation was receiving considerable attention in the British Isles (Saville, 1957, pp. 5-6). Influential people of the times engaged in discussions of the nature of the rural depopulation and whether it actually existed or was as serious as some persons thought (Ogle, 1889). At that time the conceptualization of depopulation began its primary evolution.

"Depopulation of the rural districts," then a phrase apparently very much in use, had a very fluid interpretation. Ogle wrote,

> . . . sometimes no more is meant that the population of the towns is increasing more rapidly than that of the rural districts, and, at their expense; while at other times the phrase is used more properly, and means that the population of the rural districts is diminishing absolutely, and not merely in comparison with the towns (Ogle, 1889, p. 205).

Thus, depopulation is defined operationally in a subsequent British study as "a diminution in the number of the inhabitants of a district, as compared with those enumerated at a preceding census" (Longstaff, 1893, p. 380).

This writer has incorporated in his working definition of depopulation some of the above mentioned and more universally accepted concepts relating to the depopulation phenomenon. Depopulation is defined for statistical analysis as any absolute and relative decrease or net loss in a population--a negative population change between any two consecutive censuses. The degree of areal population loss is calculated as the percent a population at the end of a decade is of its population at the decade's beginning.

There are further refinements possible in an operational definition, but as estimations sometimes have to be made for some of the basic data, there is a greater chance of obtaining more error than if a measure of depopulation is calculated from the census data. For example, agricultural depopulation is measured in a contemporary study as "the difference between actual 1961 census population of farms and the 'expected' farm population of 1961. The 'expected' farm population (is) computed by adding the estimated births and deducting the estimated deaths from the 1961 actual farm population" (Szabo, 1965, p. 39).

This measurement of depopulation generally results in areas of population loss values higher in depopulation than when only population change from census to census is used, as consideration is given to those persons who would have been born to couples in a given location had they not moved before the end of the intercensual period, essentially resulting in a measure of "apparent net migration" (Szabo, 1965, p. 25); however, because of the required estimates, the amount of error generally increases.

The fullest extent of depopulation is obtained when allowances are made for the indirect demographic effects of net migration, especially the births which would have occurred within the study if youths, young adults, and middle aged adults had not moved away during the decade. Because of the need to obtain comparability in the population data among the time periods of this dissertation and the desire to have reliability in the data, this writer has sacrificed the potentially highest measures of depopulation obtainable for a measure that gives a "balanced" or "moderate" result, i.e., intercensual population change.

As migration is in most instances the major component of the depopulation process, an analysis of the available net outmigration data could serve as a test and check respectively of: (1) the proportion of the population change and depopulation directly attributable to each of two demographic processes, migration and natural change, i.e., net outmigration and natural decrease; and (2) the adequacy of the negative population change measure in representing the full extent of depopulation. Where outmigration is high, one would expect, given outmigration is mostly composed of the reproductive population, an under representation of depopulation when the population change value is used; however, counties with considerable outmigration may have a positive population change figure because natural change remains positive and partly compensates for migration losses. Therefore, sufficiently high natural increases will conceal the population losses from migration; thus, a county may incorrectly appear through population change data not to have lost population during two censuses and not to have depopulation. Population change gives the actual difference of people living in a place on two consecutive dates, but this is a rather static and gross measure which fuses the individual effects of births, deaths, and migration. Migration could not be used in this study as the measure of depopulation for a number of reasons. Data on the migration of the farm population is incomplete. Net outmigration seldom represents all the depopulation; as high outmigration has occurred for many years among the farm population, natural decrease now accounts for much of the population losses.

Historical Depopulation

A Tentative and Theoretical Account of World-wide Depopulation

The phenomenon of depopulation, encountered in many parts of the world throughout recorded time and particularly associated with the well-to-do world in recent times should be seriously considered as an important topic by social scientists interested in theory building. The study of regressive aspects of population and cultural change (Sestini, 1962, pp. 479-490) is an important undertaking for gaining perspectives on the rise and fall of civilizations and on the consequences of man's utilization of resources and the environment.

Depopulation occurred presumably periodically throughout man's prehistory. As man through trial and error searched for more security, power, and better and more abundant resources, discovered and explored his resource base; he at times became the victim of his enemies and natural disasters and decreased in numbers in many places. There were, however, periods of time when some populations were in balance with their resources, e.g., as with some of the American Indian tribes; nevertheless, it may be presumed that as prehistoric man gained in numbers, more conflicts arose, resources at times were depleted, and man had to find a new home. It is doubtful whether at any time, all places were experiencing either stability or increases in their human populations.

With man's mental and cultural development, human decisions and actions became over generations ever more the prime forces initiating the depopulation process. Man's decisions were not always in his best interests. The natural environment changed significantly only over long geological time periods and natural disasters happening infrequently and unpredictably had a comparatively minor role in periodic reductions in the human populations. Nevertheless, the recognition of man as a change agent came relatively late in history as Buffon of France in the 18th century was the first to consider man as a powerful influence on earthly changes (James, 1972, p. 136). Although George Perkins Marsh, an American, released his Man and Nature in 1864 stressing man's actions in altering the earth, the warning was to a Nation replete with seemingly unlimited resources. Few took his words seriously until the mid-20th century, a time when his book was "rediscovered" and reprinted (Marsh, 1965).

Early man was almost completely dependent upon the land resource--the biota, soil, water, and minerals associated with it. He had to expend at times enormous amounts of labor to obtain the necessities of living. As man gained progressively more knowledge and management skills, important factors in increasing production, he began to have more leisure time to develop his culture, to live at a higher level than the local resources directly provided, and to obtain resources and goods from outside his community. At this point man began to live beyond "his" resources.

Once man had obtained tools and techniques, either indigenously or commercially, he greatly increased his effectiveness in using the local resources. This accumulation of capital, e.g., tools, seemingly at times proved to be a detriment to mankind as it made possible the release of many more resources in the shortrun from sources and areas lacking an adequate land resource base. Inadequate time remained for the renewal of some primary and necessary natural resources, e.g., soils, forest, and animals. The speeded up resource withdrawal process made feasible the growth of human populations often at the expense of other populations upon which humans depended for survival. The accumulation and application of capital goods along with the use of short term vision, the latter which is understandable given the short life expectancy, led to overpopulation, to a lower standard of living and health, and necessitated attempts to re-establish a balance between resources and people through outmigration to sparsely settled or unsettled areas. Depopulation thus took place in the areas of origin. Unfortunately, a group's way of living, preconceived notions, and adjustment abilities were frequently inappropriate for their new environments; therefore, the new settlement was sometimes abandoned. Many areas of destination, including central cities of today, have eventually had depopulation tendencies. This was the history of many places in the United States. ". . . Settlement, unsettlement, and resettlement have been the principal occupation and source of wealth in this country" (Lord, 1962, p. 348).

Especially since the Industrial Revolution man has greatly speeded up the exploitation, wastefulness, and abandonment of both the natural and his man-made environments, e.g., farms. He has characteristically disregarded his stewardship role as caretaker of the land and perceived his world in the shortrun and in terms of the necessities of life. He has failed to foresee the eventual negative longrun consequences of his actions.

Major Occurrences of Depopulation Throughout the World

Direct and inferred evidence suggests the phenomena and process of depopulation has affected the human race since its arrival upon the earth. Nearly all peoples and places appear to have been affected at least one time. Additional thought on this topic could lead to rewarding theories concerning the causes, the processes, and the consequences of depopulation. Concerning the obvious and important role population declines have had in the varying successes of peoples, nations, and civilizations, it is rather surprising that more attention has not been given to this important phase of population cycles.

The primary causes of the depopulation phase of population cycles appear to have been some different in the prehistoric societies as contrasted with most of the groups for whom we have documents; nevertheless, wider applicable generalizations and perspectives can be gained on the nature of and the basic forces contributing to population losses and their consequences by taking into account archaeological findings and the anthropological information on primitive peoples of different cultural levels. Generally, the higher developed the civilization or society, the more the population losses become associated with cultural factors. It is important to recognize, however, that in prehistoric times

> the changes were probably more rapid and violent than they are today. Thus a halving or doubling of a population during a century should almost be regarded as normal, and constancy regarded with suspicion (Hollingsworth, 1969, p. 171).

Early man's population downswings were more attributable to the sudden occurrences of natural disasters than those of historical and contemporary primitive peoples, who experienced varying adverse effects from contacts with advanced cultures.

Many population declines can be traced to the contact of two cultures with the least developed culture experiencing the losses. Petersen has listed some of the factors bringing about the decline of societies and peoples when they experience the onslaught of a more advanced culture. The resulting disease, violence, and servitude became major causes for the death and lowered fertility of millions (Petersen, 1961, pp. 334-335). Infectious diseases especially took their toll of the indigenous populations of South America even before the Spanish consolidated their control. The population of central Mexico is said to have declined within the same period, i.e., the 16th century, from 25 million to one million persons and the indigenous population of the Caribbean area nearly disappeared. The slave trade in western Africa is said to have carried off an estimated maximum of 20 million persons, only one third or less of whom survived to reach the New World (United Nations, 1973, p. 19).

The American Indian destruction came about mostly through violence; the order of events was generally ". . . first, land removal acts, expulsion, wars, and forced migrations; then, in sequence, food shortages, starvation, and epidemics . . . ." As the depopulation cycle decreased in intensity, reoccurrences of diseases, e.g., smallpox, cholera, tuberculosis, syphilis, diphtheria, dysentery, and trachoma continued to keep the population from increasing until the late 1800s (Phelps and Henderson, 1958, pp. 181-182). Finally, acculturation and the adopting of some material culture, e.g., guns and alcohol, of the invading cultures had a disabling effect upon the lesser developed societies. Social disorganization often was the consequence and where the family was affected and security lost, the raising of children was significantly discouraged (Petersen, 1961, pp. 335-336).

Seemingly, however, many cases of depopulation may be traced to the malfunctioning of a culture or society.

> Generally, the period of declining numbers is started by famine, disease, or some drastic cultural deficiency; then it proceeds to a destruction of every social institution (Phelps and Henderson, 1958, p. 181).

> That famine and pestilence ordinarily appear together suggests a direct relation between them, but apparently the usual reason is that both the supply of food and public health depend on--and can affect--the maintenance of social order (Petersen, 1961, p. 366).

Although it is generally accepted that the hunting and gathering peoples had losses in numbers, there is no consensus as to the general occurrence of depopulation among primitives of ancient times (Petersen, 1961, p. 333), but it would appear natural and man-made famine and disease have always been with the human race, and these probably inflicted casualties on man, especially through the many years that it took him to occupy the earth and through the migrations that brought him into contact with new environments and sometimes with other people.

In the preindustrial civilizations, the expansion of trade and the development of agriculture--like the later industrial revolution--brought dramatic increases in population; but, at times these agriculturally based civilizations had population decreases as famine, disease, and social disruption were encountered (Petersen, 1961, pp. 343 and 373). One by one all the ancient civilizations suffered reversals and some collapsed. Whether all these populations experienced depopulation both before and after their political setbacks or downfall is not known but undoubtedly, when social order weakened, for whatever the reasons, population losses took place. Rome is perhaps the most cited example of a civilization which fell due to certain causes, particularly internal ones. Symptoms of the disintegration appeared early in the 3rd century, before the general depopulation of the Empire with the population losses of the Roman cultural core and the Italian peninsula, the decline of agriculture, and the abandonment of arable lands. Countless efforts to bring land back into production were increasingly unsuccessful. The change and neglect in land use raised the chances and effects of disease, particularly malaria. Finally, the authorities had to resort to retraction of the settlers and agricultural workers' rights to leave the land; thus, imposing serfdom, a major characteristic of the medieval era (Petersen, 1961, pp. 366-368).

Although following the demise of the Western Roman Empire, there were numerous emigrations and invasions into the former Roman territory by various peoples, up to 1000 A.D. the continuing general decreases in the population can be attributed to adverse economic and social factors, plus the plagues of the 6th Century (United Nations, 1973, p. 16). The next general population decrease in Europe came from several devastating strikes of the Black Death in the mid-14th Century. Much of continental western Europe suffered declining or stagnant population changes; e.g., the German states lost 40 percent of their population due to the Thirty Years War. Sweden and Finland appear to have lost considerable population because of disastrous harvests and subsequent famine in the late 17th Century (Hollingsworth, 1969, p. 173). Ireland experienced large population decreases in the late 1840s because of potato crop failures, famine, and emigration (Woodham-Smith, 1962). Spain appears to have had little growth stability in its population numbers during the Middle Ages and from the 15 to 18th centuries experienced a "drastic decline" (United Nations, 1973, p. 17). Indications of the widespread nature of the depopulation in England, France, and some other parts of Europe during the last one hundred years is presented in the literature review found in Chapter II. Europe's population seems to have been particularly affected by warfare; whereas, outside of Europe, famine accounted for many population declines.

In the realm of the Eastern Roman Empire and Byzantine Empire, population losses occurred, and ". . . it seems indisputable that demographic decline accompanied economic reverses, pestilence, and wars of its last centuries" (United Nations, 1973, pp. 17-18).

As the civilizations rose and fell in the Middle East, there appears to have been extreme fluctuations in population. Egypt's population change has reeled negatively and positively several times probably due mostly to numerous invasions, wars, and exceptionally deadly epidemics. Before and during the Dark Ages, Syria appears to have lost half of its population and depopulation and abandonment of the countryside was very evident in the 18th and 19th centuries. In addition there appears to have been declines in the Asian towns of the Ottoman Empire during the same time (Hollingsworth, 1969, pp. 248-251 and 307-310).

China and India's population decreases have been particularly caused by famine, e.g., in China in 1877-1878 as many as 13 million people may have perished. Breakdowns in social order is a major theme in Chinese history. In the Taiping Rebellion (1851-1864) probably more than 30 million perished leaving some areas completely devoid of population (Petersen, 1961, pp. 363 and 369).

Given the continuance of very high population growth rates in much of the developing world, some of the above mentioned natural and social controls on population expansion could fall into operation at any time, resulting in large scale depopulation. Throughout the underdeveloped world, cityward migration has taken generally a lower proportion of the rural population than did the urbanization in the developed countries following the Industrial Revolution. The rural population continues to grow. City growth is mostly attributable to high population growth (Davis, 1965, pp. 15-19). Net population change in the developing world is expected to add more than 400 million to its rural populations in this decade, compared to the developed world whose rural population is expected to further diminish (Borgstrom, 1973, p. 249). There presently exists however some evidence that United States nonmetropolitan and rural areas are again experiencing population growth at rates exceeding those of the metropolitan areas (Beale, 1975; Zelinsky, 1975).

Yet, in spite of rapid city growth and rural-urban migration, the world is still essentially rural. The increasing socioeconomic disparities and agricultural population densities in rural areas of developing countries, plus the massive problems of the rapidly growing cities would suggest that there is growing danger of modern technological support systems breaking down under the weight of mushrooming population, opening the way to much more famine, pestilence, social disorder, and disruption. Actually, the traditional causes of depopulation have continued to operate but at reduced levels throughout modern times within the developing nations; whereas, in the industrialized world, the major underlying cause of depopulation has been technological change. New and more modern machines and methods have reduced the needs for human power. Displaced workers have sought work elsewhere, and birth rates have declined.

Selection of the Subject Population; An Agricultural Population

Heavily industrialized nations have high rates of agricultural depopulation. Overall, the most technologically advanced country is the United States. To achieve and maintain a high level of technical and economic progress, much geographical mobility of labor is required. Economically developed areas within wealthy countries exhibiting general population growth usually display agricultural depopulation.

A cartographic display of the total population changes in the last three decades in the continental United States reveals a sub-area of atypical and persistent decreases in the total population within the Northeast, a socioeconomically advanced region with general population growth. Especially striking is a contiguous pattern of the countries suffering population declines within the central area of the region, particularly in Pennsylvania. The northern and western boundaries of the State are nearly outlined by losses in stark contrast to the adjacent states (Figure 2). The question naturally arises as to the contribution of farm population losses to total population declines in this area.

If the numerical change in the entire Pennsylvania population were to be considered, many explanations would be needed to account for the geographical losses in the State's population. The entire

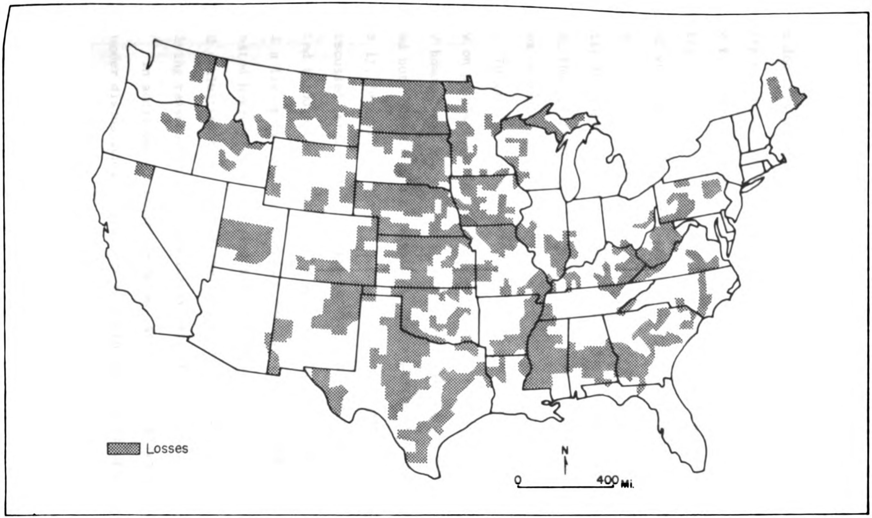

Fig. 2.--Main Areas of Population Losses, 1940 to 1970.

population does not require analysis to achieve the objectives of the proposed study; nevertheless, two of the major reasons for the population declines are given here as background for the study. The coal industry mechanized and the demand for coal fell as oil and natural gas became favored sources of energy. Pennsylvania had much heavy industry, e.g., iron and steel manufacturing in and around Pittsburgh, much of which was among the oldest such industrial activity in the Nation. The rate of modernization failed to keep pace with the more recently developed industrial areas, such as in the Great Lakes region; thus, markets were lost and so were jobs. Technological changes in one area affect other areas.

To gain an accurate assessment of the effects of new technology on population, the group chosen for study needs to be relatively homogeneous and defined. Although agriculture has fully engaged both absolutely and relatively few people in the Northeast (Table 1), Pennsylvania's rural population--the largest in the Nation and discussed later in this chapter--could have been economically affected through the decline of the agricultural population since many earned a living by servicing the farm families. This hypothesis is not tested however in this research as the major concern is directed toward evaluating the extent of the agricultural population decline and giving reasons for its historically persistent losses.

In addition, it should be noted that the Pennsylvanian subarea under discussion plus the most southern counties of upstate New York form the northern section of the officially designated Appalachian region, a large area of widespread depopulation. Common features

Table 1.--Total Experienced Civilian Labor Force in Agriculture by Region within the United States, 1950, 1960, and 1970.

Region	1950 All Persons 14 Years and Over	1960 Total Persons	1970 All Persons 16 Years and Over
Northeast	524,645	357,243	245,265
North Central	2,394,270	1,461,327	982,103
South	3,298,267	1,814,261	961,572
West	796,643	644,633	494,081

Sources: U.S. Censuses of the Population, Characteristics of the Population, U.S. Summary Volumes: 1970, Tables 300 and 301; 1960, Table 259; and 1950, Table 160.

associated with Appalachia undoubtedly underly many of the population changes in the study area.

Agricultural Depopulation in the Northern Appalachians 1910-1930

In respect to the rates of farm population losses, how did the northern Appalachian area of both Pennsylvania and New York (Table 2) compare with the population changes elsewhere in the Nation (Tables 3-4)? The analysis of both farm population estimates and census data, the latter mostly rural-farm, revealed the Northeastern region of the United States had the largest rate of agricultural population decline within the Nation from 1910-1930 which averaged roughly one percent per year. Within this same period, the losses within the Appalachian counties of New York and Pennsylvania averaged slightly higher than the rates of the Northeast, of the non-Appalachian counties of the two states, and of the Middle Atlantic division in which the two states are located. Therefore, during 1910 to 1930, the Appalachian counties of New York and Pennsylvania had collectively higher rates of agricultural depopulation than any region or division of states in the United States except perhaps in the 1910-1920 period when the average negative change rate appears to have been slightly higher in New England than the Appalachian area.[1]

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[1]The 1909-1910 farm population was calculated by the author using an estimated number of persons per farm as no census tabulation of farm population was made until the 1920 U.S. Census (Truesdell, 1926, p. 45).

Table 2.--Farm Population Change for Appalachian and Non-Appalachian Areas of New York and Pennsylvania 1910-1970.

Year	Appalachian		Non-Appalachian	
	Absolute	Percent Change	Absolute	Percent Change
		New York		
1910	257,589		663,010	
1920	221,647	-14.0	578,180	-12.8
1930	188,665	-14.9	517,781	-10.4
1940	185,753	- 1.5	530,059	+ 2.4
1950	166,607	-10.3	411,047	-22.5
1960	94,332	-43.4	224,556	-45.4
1970	52,457	-44.4	138,202	-38.5
		Pennsylvania		
1910	723,366		327,057	
1920	645,737	-10.7	302,816	- 7.4
1930	566,962	-12.2	279,278	- 7.8
1940	612,120	+ 8.0	293,048	+ 4.9
1950	487,385	-20.4	217,822	-25.7
1960	217,517	-55.4	133,421	-38.7
1970	126,366	-41.9	98,872	-25.9

Source: Calculations based on county data obtained from sources listed in Appendix B.

Table 3.--Change in Farm Population, United States, Regions and Divisions by Decades, 1920-1970.

Area	Change 1920 to 1930		Change 1930 to 1940		Change 1940 to 1950		Change 1950 to 1960		Change 1960 to 1970	
	Thou.	Pct.	Thou.	Pct.	Thou.	Pct.	Thou.	Pct.	Thou.	Pct.
United States	-1,445	-4.5	18	0.1	-7,499	-24.5	-7,413	-32.2	-5,923	-37.9
Region										
Northeast	-250	-9.9	124	5.4	-620	-25.7	-672	-37.5	-420	-37.5
North Central	-575	-5.7	-234	-2.4	-1,916	-20.5	-1,597	-21.5	-1,531	-26.2
South	-699	-4.1	36	.2	-4,504	-27.5	-4,736	-39.8	-3,405	-47.6
West	79	3.6	92	4.0	-458	-19.2	-409	-21.2	-566	-37.2
Division										
New England	-58	-9.2	48	8.4	-220	-35.3	-171	-42.4	-104	-44.7
Middle Atlantic	-192	-10.1	76	4.4	-400	-22.4	-501	-36.1	-317	-35.7
East North Central	-452	-9.1	137	3.0	-935	-20.2	-882	-23.8	-768	-27.2
West North Central	-123	-2.4	-371	-7.3	-982	-20.8	-714	-19.1	-763	-25.3
South Atlantic	-582	-9.0	146	2.5	-1,427	-23.5	-1,795	-38.7	-1,480	-52.2
East South Central	-148	-2.8	174	3.4	-1,235	-23.4	-1,554	-38.4	-1,165	-46.7
West South Central	31	.6	284	-5.3	-1,842	-36.4	-1,387	-43.1	-760	-41.6
Mountain	-36	-3.1	-25	-2.2	-259	-23.2	-181	-21.1	-232	-34.2
Pacific	115	11.1	117	10.2	-200	-15.7	-228	-21.3	-334	-39.7

Source: Banks, Vera J. and Calvin L. Beale. Farm Population Estimates, 1910-70, p. 16.

Table 4.--Change in Rural Farm Population, United States, Regions and Divisions by Decades, 1910-1970.

Area	Change 1910 to 1920		Change 1920 to 1930		Change 1930 to 1940		Change 1940 to 1950		Change 1950 to 1960		Change 1960 to 1970	
	Thou.	Pct.	Thou.	Pct.	Thou.	Pct.	Thou.	Pct.	Thou.	Pct.	Thou.	Pct.
United States	-463	-1.4	-1,201	-3.8	59	.2	-7,168	-23.7	-9,603	-41.7	-5,153	-38.3
Region												
Northeast	-382	-13.2	-224	-9.3	112	5.2	-494	-21.6	-879	-49.1	-270	-40.5
North Central	-629	-5.9	-552	-5.5	-230	-2.4	-1.826	-19.7	-2,040	-27.4	-1,408	-26.1
South	171	1.0	-512	-3.0	73	.4	-4,448	-27.2	-5,975	-50.2	-2,949	-49.8
West	378	20.9	86	4.0	104	4.7	-399	-17.2	-710	-36.8	-425	-34.9
Division												
New England	-138	-18.0	-36	-6.8	33	6.6	-128	-24.2	-223	-55.3	-86	-47.5
Mid. Atlantic	-244	-11.4	-187	-10.1	795	4.8	-365	-20.8	-656	-47.2	-284	-38.8
E.N. Central	-361	-6.9	-434	-8.9	130	2.9	-880	-19.2	-1,140	-30.8	-696	-27.1
W.N. Central	-268	-4.9	-118	-2.3	-360	-7.2	-946	-20.2	-899	-24.1	-713	-25.2
S. Atlantic	205	3.3	-519	-8.1	159	2.7	-1,405	-23.3	-2,311	-49.9	-1,268	-54.6
E.S. Central	-108	-2.0	-90	-1.7	184	3.6	-1,220	-23.2	-1.968	-48.6	-1,012	-48.6
W.S. Central	74	1.4	98	1.9	-271	-5.1	-1,823	-36.2	-1,696	-52.8	-669	-44.1
Mountain	251	27.3	-29	-2.5	-22	-2.0	-243	-22.0	-288	-33.6	-182	-32.0
Pacific	127	14.3	115	11.7	126	11.5	-157	-12.8	-421	-39.4	-243	-37.4

Source: Change and Percent Change calculated by Author from Population Censuses.

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Agricultural Depopulation in the Region During the Depression Decade

The 1930 decade represented a rather abnormal time; because of the Great Depression, there was generally a net movement of persons back to the farms (Tables 3 and 4). The Northeast particularly represented this tendency. The Pacific and New England divisions had the highest return rates. Nevertheless, the northern Appalachian counties of New York registered a negative change just as in every decade since 1910; however, Pennsylvania's Appalachian counties had their only agricultural population increase within a decade since pre-1910 and at a rate exceeding any region or division except for the Pacific and possibly New England areas.

High Rates of Farm Depopulation in the Region, 1940 to 1970

From 1940 in each decade, the Northeast experienced the second largest rate of regional farm population decline; however, in the 1940-50 and 1950-60 decades the Northeast's rate was unexpectedly close to the rates for the South (Tables 3 and 4). The rates of population loss from the farms within these two regions increased significantly and to record highs during these decades. The considerably less attention given to the agricultural population declines in the Northeast than to the South's can perhaps be partially explained by the much larger numbers of farm population involved in the South, but this does not account for the general inattention given by the authorities to the serious widespread erosion of the socioeconomic status of many farm people within the Northeast. The Middle Atlantic par

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part of the Northeast had lower rates than the New England part during this period, but declines involved more people in the former.

The Pennsylvania Appalachian loss rate from 1940 to 1950 was similar to that of the Middle Atlantic division, but from 1950 to 1970 the Pennsylvania Appalachian area's loss rates were much larger than the Middle Atlantic's (Tables 2, 3, and 4). Interestingly, New York's Appalachian area had lower rates than the Middle Atlantic area in all three decades. The 1950-60 decade (the period when the writer left the farm) was the time of the most serious negative changes in the northern Appalachian farm population as the loss of the Pennsylvania portion at -55.4 percent was of greater magnitude than any region, division, or state except for West Virginia's -62.3 percent (Banks et al., 1973, pp. 16-17). The 1950-60 decade was the period of the greatest loss rates, but although the agricultural depopulation rate for the United States decreased, rates for most areas fell very little; and thus, the ubiquitous depopulation of the farms continued at a very high level. From 1960-70 the New York Appalachian rate actually increased slightly and surpassed the Pennsylvanian Appalachian rate. Clearly the Appalachian areas of New York and Pennsylvania have had extreme losses of farm population over most decades from 1910 at rates that either closely approached those of the areas with the most relative population losses as in the South and New England, or at times as in the periods of 1920-30 and 1950-60 sustained probably the severest farm population declines in the United States.

Disregard of the Region's Farm Depopulation; Some Psycho-political Reasons

The northern Appalachian region is the largest contiguous area minimally affected by urbanization within the Northeast relative to those places adjacent to the seaboard megalopolis; yet, seemingly the recognition of the importance of the survival of agriculture in the area to the welfare of the Northeast's enormous urban population has been curiously disregarded. The northern Appalachians is the hinterland of the largest megalopolis in the world and its resources have been exploited similarly as those of the southern and central Appalachians, i.e., with the residents bearing most of the socio-economic and environmental costs. Farmer's land resources have been taxed until recently on the basis of potential nonagricultural uses. Much agricultural land has been permanently destroyed by strip mining.

The dominance of outside political and economic power accounts for much of the low economic status of the farm population in the northern Appalachians and the consequential decrease in numbers. Why these conditions have been perpetuated and have not been more widely recognized, studied, and confronted probably is closely related to: (1) the urban dominance of politics in the Northeast and (2) the West and South's control of the development of United States agricultural policy. The Northeast's urban dominated government needs to recognize the extreme importance of saving and promoting its regional agriculture and farm population through making certain the food producer is paid fairly for his products; for, in the long run the urban dweller's welfare depends upon it. The urban cost of living within the Northeast would be much lower today if recognition had been given long ago to the beneficial effects of safeguarding and promoting local agriculture. The distress within the farm population and its major causes must be recognized before any corrective action and attitudinal change can be affected.

Selection of the Study Area; The Northern Appalachians

As illustrated in the previous discussion there exists a large area in the United States that has experienced depopulation over the last several decades (Figure 2). It is to be noted however that these areas encompass a wide variety of geographical settings; and, there are many varying explanations that can be given for population losses depending on the characteristics of the area being considered. A study of the entire portion of the United States experiencing population decreases, especially recently, would present an unnecessarily complex study; with numerous complicated explanations possible, such a study would by necessity have to be somewhat superficial. As a compromise to gain deeper and more complete reasons for the population loss problem, this writer has chosen a region to analyze, for in so doing a considerable homogeneity can be assumed given the usual definitions of a region (Jensen, 1951). A locality, e.g., township, was not chosen for a micro-geographic study because areas of intermediate size, i.e., regions composed of counties are preferred for study as published data are more plentiful and accessible than on smaller minor civil division levels. Generalizations are more easily formed and conducive to a theoretically meaningful and comparative report, and the results are produced upon a geographical division ordinarily used in forming policies and instituting programs. A regional study can give a number of generalizations worthy and usable for the eventual formation of a theory of depopulation and population decline.

Areas especially prone to emigration or outmigration and thus to depopulation can be identified given some of their usual characteristics: intensity of the outflow of the population, low "resource endowments, and environmental handicaps." It has also been observed in several studies "the smaller the political region, social unit, or community, the more likely it is to be losing population" (Lowenthal and Comitas, 1962, pp. 84 and 86). Although the two case studies of Lowenthal and Comitas are from islands which are mountainous and very small in area, they are pertinent to most depopulated area studies because of the isolation factor. One island is said to have become more isolated because of advances in transport and experienced economic difficulties because of the collapse of its cash crop market (Lowenthal and Comitas, 1962, pp. 88-90). Knowledge of some basic characteristics shared by areas and regions of chronic depopulation can assist in the selection process of a study area; thus the significance of a study of depopulation can be recognized in the beginning as well as in the findings.

An area in the United States possessing some of the characteristics usually associated with depopulation as previously noted is the Appalachian Region (Figure 3) brought especially to the Nation's attention during the 1960s (U.S. President, Appalachian Regional

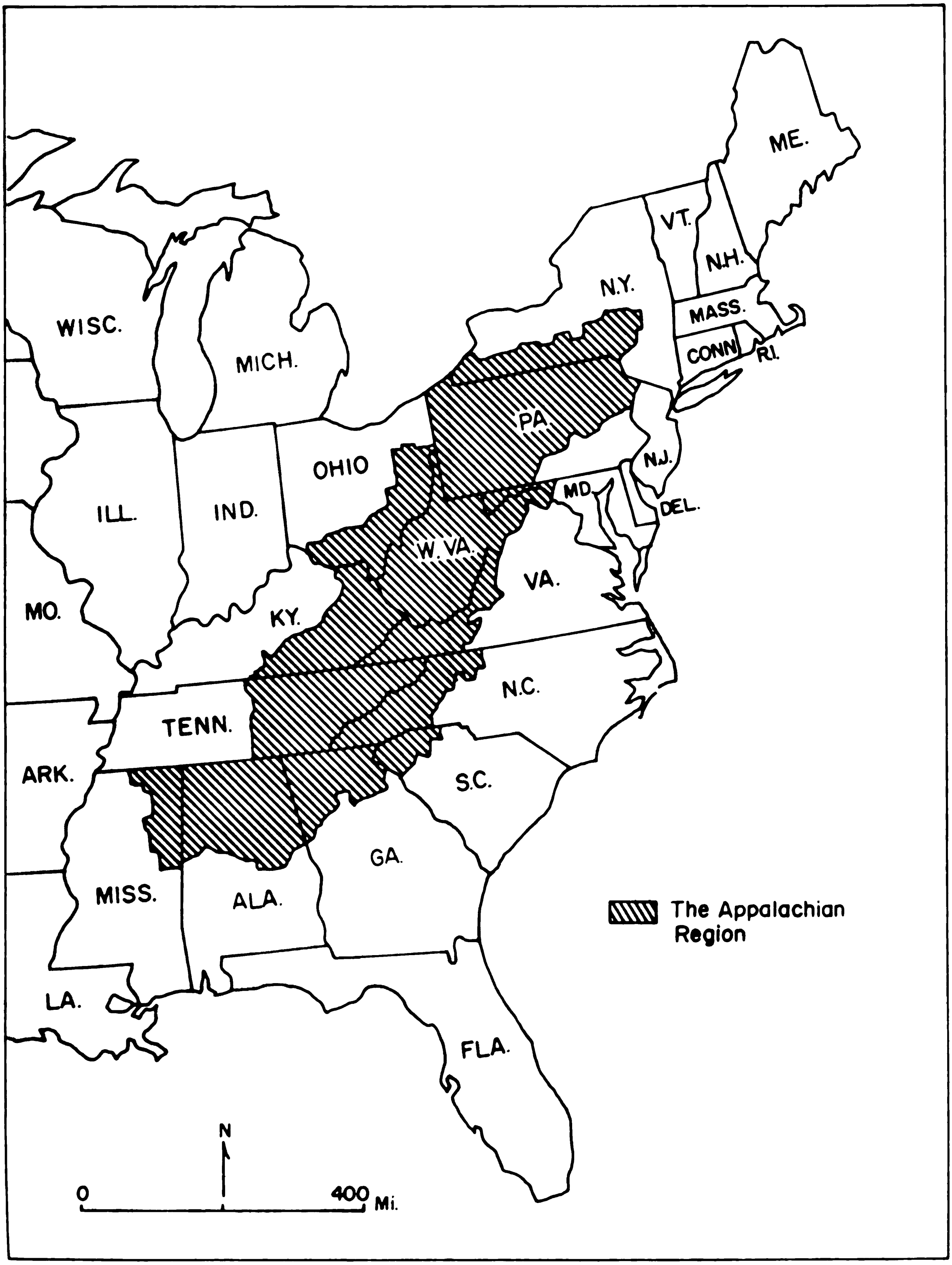

Fig. 3.--The Appalachian Region.

Commission, 1964). Numerous studies, dated throughout this century, exist on the Appalachians as is revealed in the Appalachian Bibliography (1967 and 1972); however, the great majority of these studies are on the southern and central Appalachians, long favored areas of study for sociologists, economists, and other social scientists. Much before the National Government's concentrated attention to Appalachia in the 1960s. ". . . national concern turned toward the region with substantial action" during the Depression (Rothblatt, 1971, p. 24). The considerable early public awareness of the problems of the southern two-thirds of the Appalachians resulted in the writing of major reports on this area commonly termed Appalachia (Ford, 1962 and U.S.D.A., 1935). Thus, the southern and central Appalachians have particularly attracted both popular and scholarly attention; whereas, the northern Appalachians, defined for this study as southern upstate New York and western and northern Pennsylvania (Figure 4), have received scant attention. Appalachia refers to the region delimited by the Appalachian Regional Development Act and its amendments; and, northern Appalachia includes all those counties of New York State and Pennsylvania found within the Appalachian region as so defined. The New York portion entered the program for Appalachia after the original act, and by way of an amendment, Schoharie County, New York was added in 1967 (Tyson, 1968, pp. 3-4).

The reasons for the comparative paucity of research on the northern Appalachians are not easily given, but this scarcity of studies on the area requires some attempted explanations. The northern part of the Region is more like the American mainstream of culture

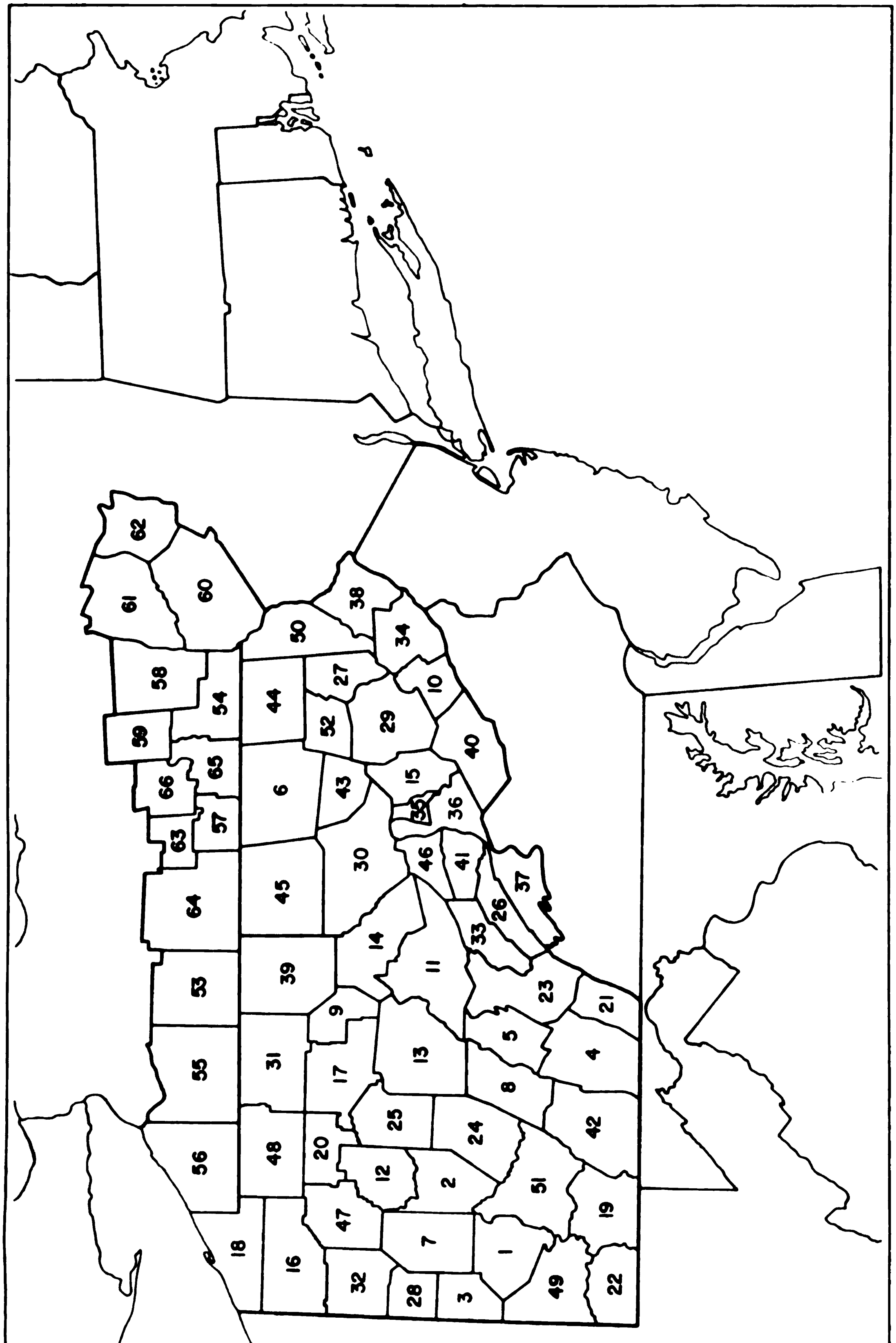

Fig. 4.--The Northern Appalachians; Counties of the Study Area.

Figure 4

County Identification Key

Pennsylvania

Figure 4

County Identification Key

Pennsylvania

1. Allegheny
2. Armstrong
3. Beaver
4. Bedford
5. Blair
6. Bradford
7. Butler
8. Cambria
9. Cameron
10. Carbon
11. Centre
12. Clarion
13. Clearfield
14. Clinton
15. Columbia
16. Crawford
17. Elk
18. Erie
19. Fayette
20. Forest
21. Fulton
22. Greene
23. Huntingdon
24. Indiana
25. Jefferson
26. Juanita
27. Lackawanna
28. Lawrence
29. Luzerne
30. Lycoming
31. McKean
32. Mercer
33. Mifflin
34. Monroe
35. Montour
36. Northumberland
37. Perry
38. Pike
39. Potter
40. Schuykill
41. Snyder
42. Somerset
43. Sullivan
44. Susquehanna
45. Tioga
46. Union
47. Venango
48. Warren
49. Washington
50. Wayne
51. Westmoreland
52. Wyoming

New York

53. Allegany
54. Broome
55. Cattaraugus
56. Chautaugua
57. Chemung
58. Chenango
59. Cortland
60. Delaware
61. Otsego
62. Schoharie
63. Schuyler
64. Steuben
65. Tioga
66. Tompkins

and undoubtedly the major differences of the culture of the southern and central sub-areas from the contemporary national culture have continued to awaken the curiosity of many researchers. The northern Appalachians have experienced large scale foreign immigration which the remainder of Appalachia has not. The central and southern Appalachian culture has been less affected by outside forces; thus, scholars desiring insight into traditional American culture find the southern and central Appalachians a rewarding "laboratory." Living conditions in the southern and central areas were perceived undesirable from a national viewpoint; however, some conditions, e.g., the density of family poverty incomes and unemployment in western Pennsylvania (Fuller and Baum, 1965, pp. 8 and 12), and the retardation of economic growth reached the most severe levels in subareas of the northern Appalachians.

If negative population growth is an indicator of undesirable living conditions, then the deterioration in quality of life in the north began near the beginning of the 20th Century, much earlier than in most of the other parts of the Region. Early industrial influences in northern Appalachia however may have attracted some people and also had an effect on lowering fertility and thus, population growth.

The majority of the southern and central Appalachian counties acquired their maximum populations by 1940 or afterwards (Zelinsky, 1962, p. 501; Hirsch, 1970, p. 90). The maintenance of high fertility rates in nonnorthern part of Appalachia (De Jong, 1968) may have kept that portion of Appalachia from experiencing much negative population change until after 1940; whereas, a number of northern Appalachian counties experienced negative population change even before the first decades of the Twentieth Century. Much of the difference in demographic history between the northern and other sections of the Appalachians can be related to the proximity of the northern Appalachians to the earliest, long dominant, and large northeastern centers of commerce and industry, e.g., New York, Philadelphia, Baltimore, and Pittsburgh, and the accompanying forces of urbanization, modernization, and the subsequent earlier demographic transition, than in the basically agrarian and rural Southeast. The northern Appalachian region, although lightly settled in many areas (Klimm, 1954), and somewhat isolated, has experienced outside influences to a much greater extent than the rest of Appalachia as northern Appalachia's situation made it the crossroads between the first recognized megalopolis (Gottmann, 1961), the urbanized northeastern seaboard of the United States, i.e., Boston to Washington, D.C., and the second major industrial and urbanized area of the Middle West, i.e., Pittsburgh to Chicago.

Northern Appalachia's location between the two largest urban regions in the United States may account for much of the outmigration from the area; however, the relative proximity of the Region to very large metropolitan areas seemingly should have held population in the Region as commuting distances to the nearest SMSA's were favorable (Hathaway, Beegle, and Bryant, 1968, p. 9). Nevertheless, over the years, with the exception of periods when mining or perhaps manufacturing was being greatly increased, Pennsylvania has revealed its generally low potential for keeping and supporting additional people through comparatively low population growth rates (Simkins, 1970, pp. 52-53), and in recent decades high rates of net migration. Over the years the counties in the Highland area (Figure 5), have particularly experienced negative population growth. Not as frequently as the Highlands area, the Appalachian Plateau portions in western Pennsylvania and the southern tier counties of New York have witnessed population declines (Figure 6). It is most significant that Pennsylvania, "the Keystone State," which possesses most of the area defined here as northern Appalachia, led during the 1960s all other states in the number of migrants it contributed to other states, with a total of nearly 400,000 (Taeuber, 1972, p. 8). The estimated loss of population through net migration for the State during the 1950s was 460,000 to 475,000 (Simkins, 1965, p. 183 and Simkins, 1970, p. 53). The State is listed among those states having a low proportion of persons born outside of the State (Petersen, 1961, p. 173) as relatively few people move into Pennsylvania. One explanation for the above population characteristics is the significant rurality of Pennsylvania.

Interestingly, Pennsylvania leads all states in total numbers of rural population; in 1960 the State had nearly a half million more rural persons than the second most rural state, North Carolina (Hathaway et al., 1968, p. 27) and by 1970 Pennsylvania's rural population increased and exceeded North Carolina's by more than a half million (Table 5). Many of these rural persons live within the Appalachian portions of the State, and although proportionately the rural population is not as large as some other states, much of the

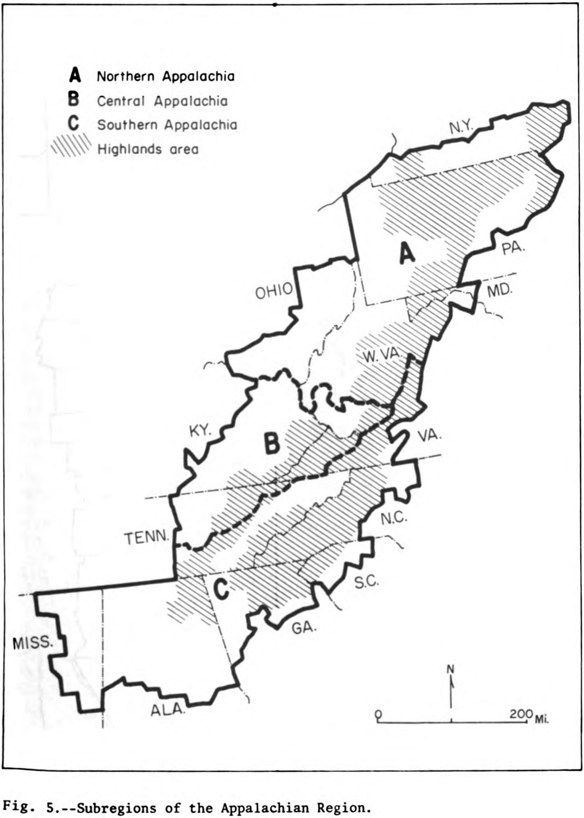

Fig. 5.--Subregions of the Appalachian Region.

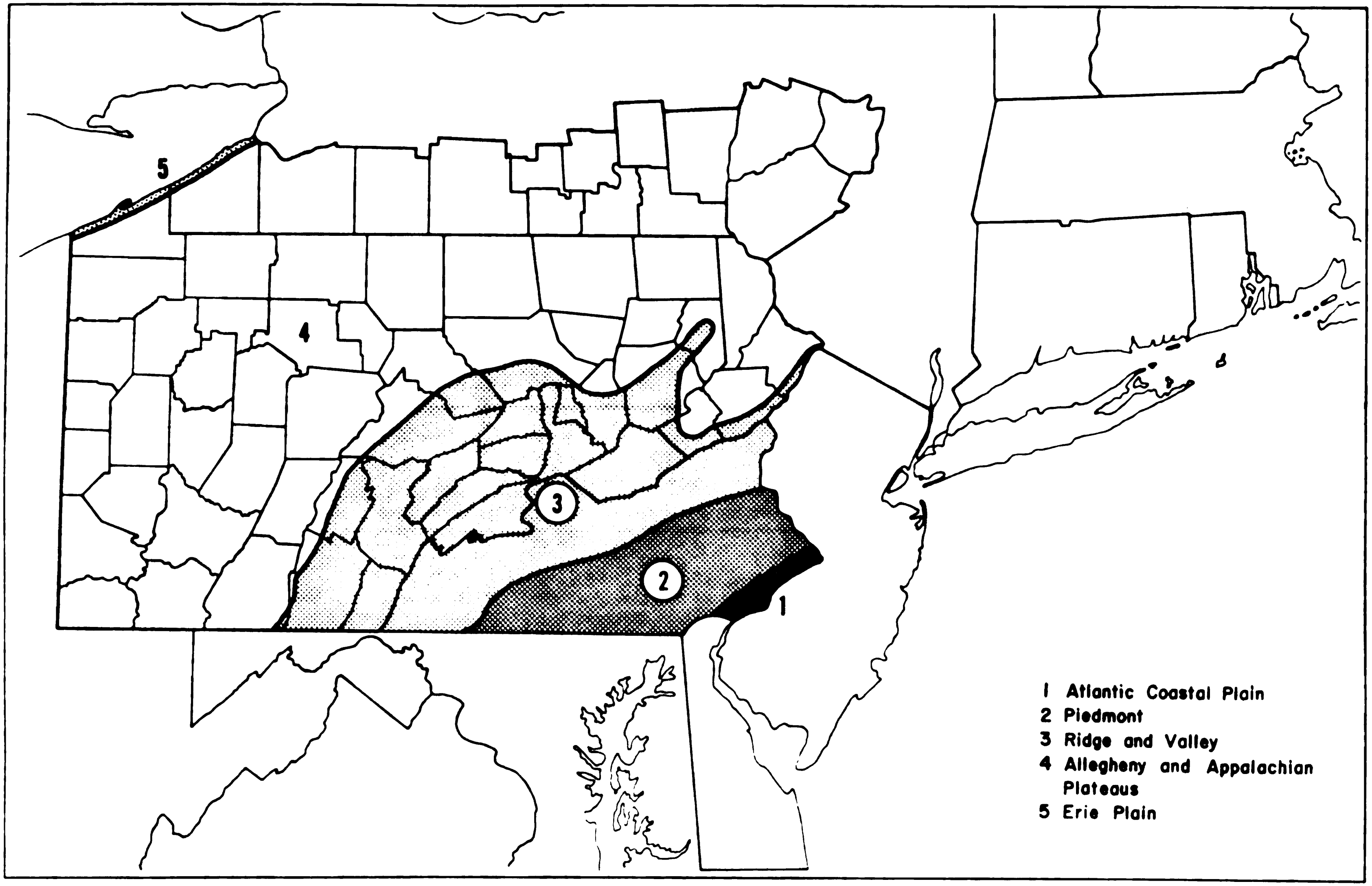

Fig. 6.--Physiographical Regions of the Northern Appalachians.

Table 5.--Rural Nonfarm and Rural Farm Population by States in the Eastern United States, 1960 and 1970.

	1960		1970	
	Rural Nonfarm	Rural Farm	Rural Nonfarm	Rural Farm
United States	40,596,990	13,444,898	45,586,707	8,292,150
New England:				
Maine	423,999	48,152	464,716	22,840
New Hampshire	234,521	18,634	311,917	9,073
Vermont	191,115	48,845	275,031	26,427
Massachusetts	810,102	35,946	860,043	18,831
Rhode Island	112,635	3,956	121,206	2,359
Connecticut	525,153	24,514	673,183	14,948
Middle Atlantic:				
New York	2,125,633	324,746	2,441,877	190,659
New Jersey	641,686	51,357	762,468	32,432
Pennsylvania	2,861,417	356,273	3,141,289	225,238
East North Central:				
Ohio	2,063,722	519,513	2,257,727	370,946
Indiana	1,266,686	485,474	1,448,069	374,590
Illinois	1,377,982	562,845	1,458,822	428,726
Michigan	1,643,125	440,937	2,042,377	277,529
Wisconsin	875,734	553,864	1,093,074	415,206
South Atlantic:				
Delaware	131,683	21,821	141,583	11,360
Maryland	736,700	110,157	855,116	62,385
District of Columbia				
Virginia	1,352,340	397,176	1,524,556	192,784
West Virginia	1,028,382	120,938	1,007,267	57,445
North Carolina	1,945,855	808,379	2,421,846	374,692
South Carolina	1,050,054	351,154	1,247,095	111,528
Georgia	1,355,602	407,278	1,651,447	171,544
Florida	1,184,758	105,419	1,250,111	72,261
East South Central:				
Kentucky	1,137,118	547,823	1,151,565	381,696
Tennessee	1,115,517	586,744	1,300,163	316,817
Alabama	1,068,716	402,855	1,271,951	159,641
Mississippi	814,497	542,839	1,019,277	210,323

Sources: U.S. Census of Population, 1960, Characteristics of the Population, U.S. Summary, Table 107; U.S. County and City Data Book, 1972, Table 1.

Note: Of the western states only four in 1970 had rural nonfarm populations exceeding one million persons: Texas (1,881,000), California (1,635,000), Louisiana (1,117,000), and Missouri (1,040,000).

northern Appalachian area is heavily rural. Many small communities greatly affect the settlement patterns (Carroll, 1971). With the decline of the primary economic activities such as lumbering, farming, and mining, along with the widespread decline in railroads (Warren, 1972, p. 11), a number of Pennsylvania cities lost population over several decades (Table 6) and some small urban places reverted, at least by census definition, to rural centers. Clearly, with many cities declining in population, urbanization explains only a small part of the recent farm depopulation in the northern Appalachians. The rural population, more than a fourth of the Pennsylvania population in 1970, depends heavily upon the primary activities; and, the recent and contemporary declines in these employments have placed many rural residents in severe socioeconomic straits.

In addition to the special rural characteristics of the population living in the northern Appalachians, the effects of changes in agriculture on the farm population make the Region a worthy setting for studying depopulation. As noted previously, the farming population in Pennsylvania and New York composes a very small percentage of the total populations of these states; i.e., 2.4 percent and 1.3 percent respectively for 1970 (Banks and Beale, 1973, p. 5); however, these minor numbers suggest the importance of programs to encourage the remaining farm population to stay in agriculture to prevent these two states becoming totally dependent on others for food.

Rationale and Importance of the Study

Most of the rationale for studies on rural or agricultural depopulation relate to either or all of the many effects that the

Table 6.--Populations of the Major Pennsylvanian Cities in the Northern Appalachians, 1930 to 1970.

	1930	1940	1950	1960	1970
Pittsburgh	669,817	671,659	676,806	604,332	520,117
Erie	115,967	116,955	130,803	138,440	129,231
Scranton	143,433	140,404	125,536	111,443	103,564
Altoona	82,054	80,214	77,177	69,407	63,115
Wilkes-Barre	86,626	86,236	76,826	63,551	58,856
Johnstown	66,993	66,668	63,232	53,949	42,476
McKeesport	54,632	55,355	51,502	45,489	37,977
New Castle	48,674	47,638	48,834	44,790	38,559
Williamsport	45,729	44,355	45,047	41,967	37,918
Hazleton	36,765	38,009	35,491	32,056	30,426
Easton	34,468	33,589	35,632	31,955	30,256
Sharon	25,908	25,622	26,454	25,267	22,653
Washington	24,545	26,166	26,280	23,545	19,827
New Kensington	16,762	24,055	25,146	23,485	20,312
Pottsville	24,300	24,530	23,640	21,659	19,715
Butler	23,568	24,477	23,482	20,975	18,691
Kingston	21,600	20,679	21,096	20,261	18,325
Dunmore	22,627	23,086	20,305	18,917	17,300
Monessen	20,268	20,257	17,896	18,424	15,216
Clairton	15,292	16,381	19,652	18,389	15,051
Uniontown	19,544	21,819	20,471	17,942	16,282
Oil City	22,075	20,379	18,581	17,692	15,033
Greensburg	16,508	16,743	16,923	17,383	15,870
Meadville	16,698	18,919	18,972	16,671	16,573
Jeannette	15,126	16,220	16,172	16,565	15,209
Beaver Falls	17,147	17,098	17,375	16,240	14,375
Nanticoke	26,043	24,387	20,160	15,601	14,632
Bradford	19,306	17,691	17,354	15,061	12,672
Duquesne City	21,396	20,693	17,620	15,019	11,410

Source: Pennsylvania Statistical Abstract, 1967, p. 11 and 1975, pp. 19-20.

temporary or permanent loss of population from an area has upon the many facets of its society, economy, government, culture, psycho-social behavior, demography, resource use or ecology; and, any such findings may serve as an important input in a successful planning effort. The effects or consequences of depopulation are not the major concern of this writing as much more research needs to be done on the conceptualization of depopulation before its consequences can be more fully understood and explained. The existence of the serious ramifications of depopulation however provide the most potent raison d'etre for this dissertation.

A growing divergence in settlements from highly concentrated to sparse states have significant implications for resource use and management in the United States. Perhaps this traditional trend has been aided and abetted because little recognition until recently has been given to the truth that human beings are the most valuable resource (Schultz, 1962), if for no other reason than their flexible laboring potential to fill multiple needs.

This study is prompted by the author's many years of living on farms and in the rural society. For more than two decades the degradation of rural society and economy was observed and experienced by this writer while living in the northern Appalachians. For many rural folks especially in certain rural areas of the United States, a "developed nation," day-to-day living is a real and ever more tiring struggle which worsens with increasing age and loss of sons and daughters to distant urbanized and industrialized places. "The population that remains in such communities exist in a chronically depressed condition and constitute a major national welfare problem" (Bogue, 1969, p. 8). Most rural people have very limited means or know-how to cope with the impersonal forces that have made them the victims of progress and many blame themselves for their failure to succeed. In a very real sense an originally rewarding way of life and society, i.e., agrarian and small town in the United States, has succumbed to political and economic forces and negative effects of change. Change has commonly received widespread support in the United States as being completely good and virtuous, but obviously, these pronouncements are written and spoken by influential persons who have benefited by "progress," for those who have paid the costs and have received minimal benefits seldom gain the opportunity or influence to express effectively to the public and authorities the countervailing results produced by a "change for change" policy.

This study grows out of a value base. Any researcher, specifically here a geographer, is inescapably guided by his own values when establishing objectives for an investigation (Harvey, 1969, pp. 3-4).

The author's empirical assessment is that the farm society in many places within the United States has suffered extraordinary degrees of deterioration. The disappearance of farming as a way of life in many areas will certainly lower the richness of American life. The public needs to be aware of the dangers of encouraging capital use expansion in farming and of favoring agribusiness. Cheap food should not be the major objective of agricultural policy. The retention of the population in the rural areas to maintain viable communities and to reduce the number of people completely dependent on others for all their necessities of life should have first priority. Unemployment will continue to increase if ways are not found to employ more people upon the land. Because of the large proportion of the American population now urbanized the achievement of the above presents a very formidable task, for it is now the urban population whose attitudes and votes will determine the direction of politics, farm policy, and farm programs. A new state of awareness to the farm population's precarious existence and an understanding, appreciation, and respect for farm people and the rural society is vitally needed to insure the social and economic well-being of the nation.

In this age of stress on equal rights and commercialization, perhaps it is difficult to understand why not everyone should desire to be like everyone else. People are brought up in different social-cultural environments; the learnings and values obtained from these early experiences are carried throughout a lifetime, making the adjustments to a new environment and to a new way of living much more difficult than is usually realized. Of the two main types of forces motivating migration, expulsion, rather than attraction, is believed by Haddon (1912) to be the most influential. "People are psychologically reluctant to leave their traditional homes without strong forces forcing them to do so" (Kasdan, 1970, p. 2). The gap between rural and urban life settings is still significantly wide in most of the developing world which composes more than half of the world's population; and surprisingly this difference in natural and social environments still exists within the highly developed nations, including the United States. Whether people are forced or enticed to urban settings from the rural society, there exists commonly among rural-urban migrants a sense of personal loss, a separation and dis-association from the urban society. People need a wide range of choices in life styles and environments in which to live, to most effectively use their abilities and follow their interests. Without conservation of rural ways of living, the probabilities of finding a satisfactory living style for many personalities are needlessly lowered. Could it be that part of the increasing crime of the cities is explained somewhat by the unemployment or inadequate and makeshift nature of jobs and the lack of alternative environments for many persons who would for example prefer more self reliance and a slower pace of living?

Other adverse developments are foreseen with fewer members of the farm society. The control of food production is falling into the hands of fewer people, who are better able to get together, organize, and establish prices. Consumers are however numerous and more difficult to organize for combating high prices. Fewer persons own agricultural land as farm consolidation continues. With the loss of direct access to the land, more and more people are finding themselves too interdependent, less self-reliant, and further away from the necessities of life and the resources from which they are derived. A considerable degree of security and independence is lost in one's life when he finds himself completely at the mercy of other people for all necessities of life. As our economy and society becomes more complex, ever more dependent on special interest groups, e.g., truckers, railroaders, food processors, and chemical manufacturers, any failure in one portion of the highly artificial food system, could mean disaster for countless millions of people.

Agricultural Development with Social Planning

> It is interesting to speculate about how United States urban problems would be different today if America's agricultural revolution had been accompanied by some such large-scale program for planning, mitigating, and stretching out the social effects of the depopulation of the countryside (McLin, 1969, p. 11).

The preceding quotation refers to western Europe. In the Common Market area, nearly 90 percent of the farms are family operated and in an area one-third that of the United States, an agricultural population lives which is several times the percent of the United States population on farms. Why therefore, cannot the United States support more farm people? Although the farm population in this part of Europe declined between 1960-1970, there appears a continuance of European hesitancy to removing what many agro-industrialists consider a redundant population (Bracey, 1971, pp. 123-125). The decision to follow an American as opposed to a Chinese agricultural settlement model has not been clearly decided (Walters, 1973, pp. 187-189), but it appears that in attitude toward saving the agrarian society and family farming, the Europeans are much more determined to do so than the Americans. Yet, even in Europe,

> the small European farmer represents a simpler society which the agro-industrialists consider not worth preserving. He is redundant, and should be paid to get off the land on which his family may have gained a living for centuries. But, to stem the drift of young people to the towns, surely governments should seek not only to preserve the countryside but also to preserve the populations indigenous to it (Walters, 1973, p. 189).

It seems clear that an ecological balance in population between rural and urban areas needs to be planned, and the economy planned to make it work.

Human Living Conditions and Public Policy

Policies using migration as the major change mechanism have resulted in serious hardships for many rural and farm families, through the worsening of rural living conditions. Vast rural areas and rural populations have retrogressed significantly through the absence of a well thought out rural development policy with appropriately planned programs.

Public policies have had much input from laissez faire economics. Much of the rural difficulties result from past unworkable and unsuccessful agricultural programs stressing production, especially from increasing economics of scale or bigness of the agricultural production unit. Tweeten (1965) has found the large commercial farms to be more vulnerable to price decreases in the shortrun than the smaller production units (Milk, 1972, p. 232). The long time emphasis on production probably explains much of the serious neglect of rural human concerns, e.g., no specific United States manpower policy was developed for the displaced agricultural workers (Bishop, 1967, p. 15), who lost their jobs, usually not due to any fault of their own, but often because of the effects of national agricultural policy. With greatly increased production, it seems paradoxical that poverty should still be a major fact of life in some areas and sectors of the United States economy. Many farm people have long had low incomes when compared to the nonfarm workers; and, this "poverty," the low standard of living, and the deteriorating living conditions are almost certainly significantly related to and a major cause of the depopulation of American farms. Therefore, one might ask justifiably: has the basic agricultural policy of the United States proved at all successful, given that there continues to be a large proportion of the farm population at the poverty level although a very large off-the-farm migration has continued for several decades? Gans has printed a relevant commentary.

> Clearly, then, poverty and the poor serve a number of functions for affluent groups--households, professions, institutions, corporations, and classes, among others--thus contributing to the persistence of these groups . . . (Gans, 1968, pp. 105-106).

General Guides to the Research

A major motivating force underlying this research is to determine as nearly as possible the meaning of depopulation. Closely allied with this mental puzzle are also the characteristics of the depopulated state of affairs and the changes through which this general but abnormal condition of life came to be. The word abnormal is used because certainly in viewing an adequate quality of life for an area the existence of the characteristics coming from depopulation would be considered undesirable. Some characteristics of depopulated states, areas, or places can be listed and some of the steps culminating in depopulation elucidated. To understand the processes of depopulation, the study of evolutionary events through history is considered indispensable. The events emphasized in the following work are especially related to agricultural changes as the agricultural population is the focus of the research.

Additional aspects of the descriptive part of this dissertation are to locate and to measure as accurately as possible for the northern Appalachians the spatial patterns of significant decreases in the agricultural population during the time periods most affected by the losses. The areal and temporal farm depopulation statistical patterns are useful in establishing reasons for the movement of the farm population out of agriculture. Some of the questions which must be asked and answered to achieve this collective objective are:

(1) What variable, once a clear definition is obtained for depopulation, can be operationalized and can serve as the most accurate dependent variable representing the extent of depopulation--given several constraints, e.g., data availability and variation in the population composition?

(2) When did the Appalachian portions of New York and Pennsylvania begin to lose population and particularly farm population?

(3) What are the major time periods or eras of farm depopulation in the northern Appalachians?

(4) What areas, i.e., groupings of counties, experienced various levels of agricultural depopulation during these periods?

(5) What are some of the common agricultural, socioeconomic, and environmental characteristics of each set of counties grouped by the magnitude of the farm population losses?

The central objective of this study is to provide explanations particularly for the recently large farm population decreases via a search for significant causes, especially the "push factors" contributing to the agricultural population losses. These factors have frequently been neglected in the movement of people out of an area and "pull factors" emphasized and analyzed instead (Sly, 1971, p. 5). As farm people have traditionally identified with and earned their living from the land, probably more than any other group, it seems reasonable to assume that the "push factors" influence their decisions to stay or go from the land more than do "pull factors." As agriculture is the major means of livelihood for most farm people, it is presumed that significant changes in the nature of farming, would have great influence on whether a farm person stayed or moved from the farm.

The nature of agriculture is viewed primarily as embodying several agricultural systems and or types, each consisting of several criteria or factors basically characterizing the systems or types. The general outward appearance of farming, or type of farming, e.g., dairying, general farm, and cash crop, will have changed ordinarily slightly; however, the arrangement and individual importance of the criteria and components of and within each kind of agriculture or agricultural system, will have changed considerably. In analyzing the effect of agricultural changes on the farm population, one may prefer to regard agriculture as composed of various subsystems and elements; then, such pertinent questions as what are each system's environment, resources, and components can be more adequately answered (Dent and Anderson, 1971, p. 344).

The loss of farm population from an area is seen as taking place only under certain inadequate and unsatisfactory conditions. Some conditions of society, economy, and environment, especially related to agriculture, are thus explored and associated with agricultural depopulation.

A major encompassing purpose of this presentation is to explore a portion of the interface of population and agricultural geography, two subfields or specialties within the discipline of geography that if interrelated to a much greater extent in future geographical research could supply many revealing insights and answers to many of the ills now confronting mankind.

Finally, this study raises some questions regarding the wisdom and adequacy of past and present public policies and programs in rural development, agriculture, and social welfare. This regional study on northern Appalachia is initiated in part to disclose the inconsistency of policies to assist declining areas through encouraging outmigration. These policies based primarily upon migration from depressed areas generally have proven unsuccessful in bringing rural resources in balance with the rural population because they have lowered an area's ability to use its own resources. In the future it will be more important to predict the consequences of policies and programs on each region's populations before the implementation of such and damage is done to certain groups. Tradeoffs often must be made in establishing solutions but the costs should be distributed as equally as possible.

CHAPTER 2

A REVIEW OF DEPOPULATION AND RELATED RESEARCH: A BASIS OF THEORETICAL IDEAS

An Interdisciplinary and Chronological Overview

The literature cited in and surveyed for this review is not to be considered the total work available on depopulation; nevertheless, the literature on depopulation that is discussed in this study has come from a number of academic disciplines including geography, rural sociology, demography, agricultural economics, economics, anthropology, history, and the general collective field of government, political science, and planning. Many of the references have been discovered by chance and it has not been possible to systematically search the literature in all the involved disciplines. It is nonetheless apparent that the topic attracts the attention of scholars in many fields; but, there is little evidence of cross disciplinary research and exchange of ideas. The major exception to the straight discipline approach is to be found in the proceedings resulting from the European Conference of the Local Authorities (1968). Certainly, an obvious need exists for annotating and abstracting a bibliography on the whole general topic of rural population decrease.

A rather extensive literature exists on various subtopics of rural population decreases which is only considered in this study at relative points where it presents important ideas relevant to this thesis. Examples of these subtopics are: rural exodus, declining communities, natural decrease, rural-urban migration, and net out-migration.

The French had a very early interest in depopulation (Jaubert, 1767) and French literature (Bertillon, 1897 and 1911; Dumont, 1890; Parodi, 1897) discussed the subject around the era when members of the Royal Statistical Society in Great Britain debated the seriousness and extent of rural depopulation during the late 1890s and early 1900s (Ogle, 1889; Longstaff, 1893; Graham, 1892; Eversley, 1907). An emphasis on the economics of rural depopulation appeared in an article by Roxby in 1912.

Thompson (1925) explored the relationships between urbanization and rural depopulation in France, and in the United States that had significant rural-urban migration also, related studies were done (Carver, 1927; Goldthwait, 1927). The presence of prosperity probably led many scholars to conclude rural-urban migration contributed to the nation's economic growth.

One may speculate how the concept of depopulation was introduced to the United States; nevertheless, by the 1920s and 1930s when the birth rates plummeted in many of the industrial countries and the extent of rural outmigration was recognized as people began moving back to the rural lands to survive the Depression, sociologists and economists (Gee, 1929 and 1933; Reuss, 1937; Smith, 1938; Spengler, 1938) awoke to the possible effects of rural population losses and "flight from the land." With the continued lowering of birth rates in the 1930 decade, demographers became interested in the general subject of population decline, and Dorn's note on the natural decrease of population in some rural and urban places in the United States (Dorn, 1939) was expressive of concerns over an increasing tendency toward negative natural change in populations, seemingly akin to Spengler's theme. During the same decade geographers expressed apparently the first genuine interest in the phenomenon with an article on mountain depopulation, a subtopic with special pertinence to the geographical emphasis of this study (Toniolo, 1937).

After World War II, publications revealed an increasing geographical interest in studying and reporting on depopulation in various places. A study of southwestern Ontario presented a challenging analysis of sequential developments resulting in general rural depopulation (Watson, 1947). Watson concluded that general rural depopulation during the last half of the 1800s came from neither the occupance and then abandonment of submarginal farm land, nor the general deterioration of the physical environment because the first places to decline were not necessarily the ones with poor soils and adverse physical conditions for agriculture. Furthermore, depopulation first began with the migration of the nonfarm population who were influenced by the social and economic changes and ideas originating from the nearby cities. Depopulation continued while the state of agriculture continued to improve during the period. Nevertheless, an out movement of the farm population, starting in the late 19th century and continuing over to the 20th century, gained its impetus both from the attraction and competition of the West and changes in farming methods (Watson, 1947, pp. 147-151).

An indication of geographers' expanding concern for rural population decline is the number of their studies published during the 1960 decade (Lowenthal and Comitas, 1962; Field, 1963; Szabo, 1965; Lawton, 1967; Pinchemel, 1969). Lowenthal and Comitas decry however the slight attention given to the widespread extent of depopulation and places that people migrate from, and give examples of places which have experienced emigration and depopulation and some of the consequences that have ensued, in an attempt to ". . . stimulate interest in a neglected and fruitful field of inquiry" (Lowenthal and Comitas, 1962, pp. 83-84).

A cursory look at other geography works on population decline during the decade, reveals the global extent of the depopulation phenomenon. Often there are extreme differences in the rural depopulation rates within a nation's boundaries. An example is the U.S.S.R. where the Slavic rural people are leaving the countryside whereas the rural minority ethnic groups are generally staying. In addition, a condition in one country which would encourage outmigration from rural areas may not be sufficient to do so in another country. In the Soviet Union there are high rural densities and population pressures upon the farm land in many places, but this has not motivated non-Slavic Russians to migrate from the land, a tendency which discourages the development and use of new technology to conserve labor (Field, 1963, p. 477). The out movement of the youth from the western parts of the U.S.S.R. apparently continues at a very high level (Murarka, 1975, pp. 1 and 4). Yet, a study of farm depopulation in the south-central plains of Canada, where population densities are low and minority numbers (of non-English speaking origin) are significant, shows depopulation occurs where there are relatively important interrelationships between depopulation and the economic conditions of agriculture (Szabo, 1971, p. 36).

The writing on rural depopulation in France by Pinchemel (1969) is an excellent example of the multi-perspectives geographers can use in analyzing a problem. This recent study of the rural population declines in France is a very important prologue to the theory, typology, and methodology of rural depopulation; its reading is an absolute necessity for any scholar interested in depopulation of the countryside. Stressed particularly in this article are both the simple and complex factors and types of rural depopulation. Causes of a general or primary nature are considered separately from the secondary causes.

Lawton's recent presentation (1967) of the historical geography of rural depopulation in England in the last century is a valuable summation of findings from the literature and an account of the spawning of rural depopulation in the nation where the Industrial Revolution began. This study is particularly important as it gives possible ways rural areas may be delimited using population data on: (1) density, (2) persons engaged in primary occupations, and (3) certain administrative units. Closely related to the determination of rural areas is consideration of the definition of rural population which is critical to any assessment of the extent of rural depopulation (Lawton, 1967, pp. 230-233).

The Nature of the Depopulation Phenomena

Definitions of Depopulation

Definitions frequently contain information closely related to measurement; this is to be expected as both definition and measure are closely associated--one is needed to make meaningful the other. Nevertheless, in this presentation separate consideration is given to the concepts and the employed parameters of depopulation in an effort to simplify the discussion.

In the introduction of this study several definitions, particularly ones that could be operationalized, that is put in the form of a measure, are quoted from selected works on depopulation. The main substance of these definitions will be summarized in this chapter. Relative ideas that will add to the clarity and full meaning of the term depopulation will be added by a review of the depopulation literature.

An analysis of the meaning of depopulation in a pertinent work will frequently reveal an author's assumption that there has to be present ". . . a substantial continuing decline in population" (Great Britain Ministry, 1964, p. 1) which is "diminishing absolutely" (Ogle, 1889, p. 205 and Lawton, 1967, p. 230) for depopulation to be present. This is to say if the total selected population of a chosen area decreases during a sufficiently long time period, depopulation is considered occurring. The majority of studies use census time periods, ordinarily of ten years duration and areas which are political subdivisions. Long term depopulation is generally associated with negative population change.

There are a number of additional meanings that authors have given to the depopulation phenomena. A large proportion of studies containing the term, depopulation, in their titles equate exodus or flight from the land and rural-urban migration with depopulation as a process (Bogue, 1969, p. 8; Council of Europe, 1968, Vol. 1, pp. 89-90; Field, 1963, p. 465; Stockwell, 1968, pp. 269-271). Outmigration is a demographic process directly causing depopulation; however, natural decrease is another demographic process contributing some effects, especially after much outmigration, on population change and the ecology of the source area. Spengler primarily restricted the meaning of depopulation in his study of France to ". . . a persistent long-run excess of deaths over births" (Spengler, 1938, p. 3), and studied negative natural change due mostly to lowering fertility. Such an interpretation of depopulation at the national level is adequate if limited net outmigration has taken place, but studies of a similar nature involving civil divisions of nations permitting freedom of movement must give sufficient analytical treatment of migration if the depopulation phenomena is to be understood. In contrast, if the emphasis is on the role of natural population change in population decline, an analysis restricted to natural population decrease can be justified (Beale, 1969; Dorn, 1939).

In particular, the term depopulation implies studies of a broad and comprehensive scope. Toniolo states:

> . . . mountain depopulation has been defined as covering not only the larger causes for the decline in population but also "the total or partial abandonment of territory by the inhabitants . . . with the continuous or intermittent shifting of centers of rural life and the deterioration of geographico-economic conditions in the regions under examination" (Toniolo, 1937, p. 473).

Extensive conceptualizations of depopulation are found in a number of monographs written on the topic (Great Britain Ministry, 1964; Hutchinson, 1963; Rivers, 1922; Saville, 1957). It is worthy of note that although the term seems to imply an area will eventually be depleted of its population (Browder, 1963, p. 31), Toniolo (1937) interprets the subject as also a "partial" loss of population for an area. The "larger causes" and the remaining content of his statement on the meaning of depopulation strongly imply that he saw the term depopulation as including the process of depopulation, the various causative processes, and the subsequent effects and resultant conditions.

When depopulation is assessed as a serious problem, the effects and consequential conditions of depopulation are especially viewed as additional senses of the term. In some studies there is the especially clear implication that the process of depopulation can be seen at work in some of the changing forms and patterns of settlement (Bogue, 1969, p. 8; Watson, 1947, pp. 152-153). Thus, as will be subsequently discussed, a temporal process is often also a spatial process which merges with evolving spatial forms and spatial structures. Frequently, the social and economic conditions of an area experiencing population losses are seemingly considered as integral characteristics and a part of depopulation (Bollinger, 1972, p. 567; Bracey, 1958, pp. 387-388; Council of Europe, 1968, pp. 89-90; Lowenthal and Comitas, 1962, pp. 89-93; MacDougall, 1973, pp. 57-91 and 123-148; Young, 1972, pp. 289-300).

Some of the meaning of depopulation is inseparable from the nature of the population being studied as their characteristics affect the type of depopulation examined, e.g., mountain, rural, nonfarm, agricultural, or central city, each of which has its own deviations from the general conceptualization of depopulation. For example, as the agricultural population is associated with large land areas, there needs to be the inclusion of land abandonment in the formulation of the general agricultural depopulation process; whereas, in the central city situations a primary concern would be the abandoned housing. A conceptualization of depopulation to result in the most meaningful and revealing studies needs to be stated from a human ecological perspective, that is with sufficient consideration given to the role of physical, economic, and social environmental factors in the depopulation process.

Measurements of Depopulation

Population change in both absolute and relative figures for a census period, or from census to census, is the traditional measure of depopulation; however, there are other adequate and perhaps superior measures. The selected parameter is dependent upon the purpose(s) of the research. For example, Stockwell has written

> . . . the precise impact (consequences) of population decline would differ depending not so much on the magnitude of population loss as on the processes through which depopulation was being achieved (Stockwell, 1969, p. 552).

Accordingly, he advocates the use of the "ratio of total population loss to migration loss" which means, for example, the smaller the ratio, the more migration loss is compensated for by an excess of births over deaths. Any ratio greater than one indicates both natural decrease and outmigration are occurring. The more outmigration is balanced by natural increase the less serious are the conditional characteristics of the source population (Stockwell, 1969, pp. 552-555). When over a given time period net outmigration exceeds natural population increase, depopulation has taken place (Gade, 1972, p. 16).

An important measure of population losses is density, a concept especially favored by geographers because it includes the spatial emphasis and is pertinent to the man-land theme in geography. A recent substantial European report of rural depopulation suggests it ". . . occurs when the population density in rural areas falls and . . . there may be a flight from agriculture without rural depopulation in the sense just defined" (Council of Europe, 1968, Vol. 1, p. 10). Geographers studying population losses have taken little advantage of this potentially valuable geographical ratio. There are a few exceptions (Field, 1963; Hartshorne, 1939; Pinchemel, 1969, p. 113). As the depopulation concept implies a population change in association with and an effect upon some territory or earth surface area, a more meaningful parameter of population decrease could be obtained by taking into account an often variable land area, i.e., the sum total of land resources. Whether a decrease in the farm population is measured in comparison to total county area, farm acreage, or crop-land acreage could result in quite different assessments of population decrease.

A small number of students of population decline apparently find population change too gross of a dependent variable; thus, they may analyze the active demographic components of population change, i.e., migration and natural change (Bollinger, 1972, pp. 572-573; Lawton, 1967, pp. 230 and 237-247). As many writers and researchers have viewed depopulation primarily as outmigration, various possible means for computing migration, representing several levels of refinement are possible. The residual method calculates the "expected" population for the end of a census period, given the addition of a certain natural change figured from the difference of births and deaths. The difference between the "expected" population and the actual population counted by the census, the residual, represents the "apparent migration." A ratio, a relative number required for some statistical tests, may be "obtained by relating the number of apparent migrants to the expected population" at the end of a given time period (Szabo, 1971, pp. 25 and 39).

A somewhat general and rough measure used especially in the older rural depopulation studies to reveal the relative loss of population or to infer a loss of population in the rural areas was either the change in the proportion of the total population that was urban or the rate of increase in the urban population during a given time for each areal unit (Lawton, 1967, pp. 227-228; Longstaff, 1893; Ogle, 1889, p. 205). In a like manner, the loss in rural farm population can be represented by "the rate of decline in the proportion of the population classified as rural farm from one time period to another" (Leuthold, 1968, p. 7).

A measure called appropriately the "depopulation ratio" recently introduced in the anthropological literature, may have potentially wider applicability in the study of declining populations over various periods of time and for different sized areas. Such a value is ". . . established by comparison of relative numbers of a given group at two points in time. One such time should be that when the population analyzed fell to its lowest numerical strength," termed the "nadir" population (Dobyns, 1966, p. 412). The depopulation ratio is particularly useful in gaining some summary or overall quantification of population decrease over a long time where the population has reached its lowest points in contemporary times and the maximum of the population is unknown. Various estimates are used for the zenith populations for several regions or areas, and the reasonability of these are tested by comparing the several depopulation ratios (Smith, 1970). This situation is analogous to the American farm population whose official high numbers are unknown except for estimates prior to the census of 1920, but perhaps this data could be more accurately estimated by using the depopulation ratio method.

Classifications: Types of Depopulation

The most common basis for classifying populations undergoing losses is by the relative location of the residence, i.e., rural nonfarm, rural farm, rural, and urban. A similar means for classifying is by the dominant physical feature of an area, e.g., Toniolo (1937) investigated "mountain depopulation" and Hunter (1966 and 1967) explored the reasons for and consequences of "uninhabitable riverine areas." Because residential characteristics are so frequently used to generally describe depopulation, strong geographical associations are evident in the phenomenon's conceptualizations.

Three kinds of areas of population decline can be listed according to the importance and the extent of the changes in the components of population change, namely natural change (births minus deaths) and migration. These are: (1) natural decrease of population and outward migration, (2) natural increase of population and outward migration, and (3) natural decrease of population and inward migration (Great Britain Ministry, 1964, p. 34). In a fundamentally occupational based classification by Pinchemel (1969), consideration is also given to the role of natural change and migration in the depopulation process.

Pinchemel seems to be the one author who has treated classification of depopulation with respect. His organization of the phenomenon is primarily via occupation, but in addition, he gives much insight to the arrangement of causes, listing the general, complementary and accidental, and secondary factors (Pinchemel, 1969, pp. 113-115). He outlines his defined types of rural depopulation as follows (Pinchemel, 1969, pp. 115-116):

I. Non-occupational depopulation
    A. ". . . excess of deaths over births . . ."
    B. ". . . departure of young people . . ."
II. Occupational depopulation
    A. decline of the farming class
    B. decline of the agricultural wage earners
    C. decline in the rural nonfarm occupations

Much depopulation is not general in effect, but selective. As population is the central subject of depopulation research, more effective analyses could be achieved if, as in migration, natality, and mortality studies, additional "demographically-relevant" data, i.e., age, sex, race, ethnicity, and marital status, were used to specify and more fully define the dependent variable (Mangalam, 1968, pp. 4-5). The significant role of family migration through the movement of the spouse and children with or to join the head of the family and a change in marital status is clear in the large proportion of internal migration explained by these noneconomic factors (Petersen, 1968, p. 288).

Some types of depopulation may be expected following the occurrence of a previous series of events. The decrease in people providing services, for example, could be expected when a decline in the agricultural population occurs within an area especially dependent upon farming. Likewise, one could expect to have natural decreases in a population which had experienced a long history of outward migration. In many places "relative" depopulation could possibly occur for years without much societal damage if it was at a low level. The disruptions in a way of life become significant, however, when depopulation becomes absolute and selective or "specific" effecting particular areas, special kinds of workers, and certain groups of people.

General Locational and Spatial Patterns of Depopulation

Places and areas that continue to lose people tend to be alike in general locational and spatial attributes. Knowledge of these geographical generalities could give important clues to the basic cause of depopulation. In addition, an understanding of the comparative characteristics of the source areas of migrants could greatly assist the authorities in planning successful programs of assistance for "the people left behind" and the displaced outmigrants.

Rural areas have traditionally supplied the surplus human resources for urban growth. Because the population composition of the "countryside" and the characteristics of its cultural and physical geography are not the same everywhere, depopulation has varied through time and space. As rural territories have generally experienced more population losses than urban places, the discussion here will be restricted to the particular kinds of rural residences and groups associated with depopulation.

Rurality, rural-farm, and distance. The more rural an area is, the greater its population losses (Saville, 1957, p. 7). The question that immediately follows, of course, is how are degrees of rurality to be measured? In recent United States censuses of population rural residences are subdivided into two major categories: rural-farm and rural-nonfarm; however, the latter population group is a heterogeneous residual of the farm population, and as such valid generalizations applicable to it are most difficult to make. Conversely, the rural-farm population is relatively small, having for the

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most part groups of persons with similar social and economic characteristics, working principally in agriculture and living in comparable settlements. Some distinct characteristics of the farm population justifies the continued separate tabulation and analysis of data for this group (Beale, 1957).

Rural-farm populations associated with agricultural areas in a quasi-historical sense are assumed to represent a higher level of rurality than any of the rural-nonfarm population groups. For example, American farm people live primarily on individual and isolated farmsteads; whereas, miners live usually in agglomerated settlements. One measure of rurality is the percent of the labor force employed in farming, but this puts too much emphasis on the contributions of agriculture to the rural society, when interests of the causal factors of population characteristics extend beyond occupation. Measures of rurality based upon the distance of a county from an urban area and the size of an urban area (Hathaway et al., 1968, p. 7) contain the important influence that urbanism exerts upon rural areas and people. Thus, rurality is conceived as the opposite of urbanism. In retrospect there appears to be two factors which represent maximums of rurality: (1) agricultural settlement and/or agricultural occupation and (2) location away from the nearest urban area tempered by the population size of the urban agglomeration.

The initial urban effect on adjacent rural areas. Many studies of rural population decline indicate that the places and areas most remote from cities have experienced the most continuous losses and depopulation tendencies (Bracey, 1958, p. 387; Lowenthal, 1975,

p. 39; Newman, 1967, pp. 50-53; Reuss, 1937). Added to the characteristics of these locations is the sparsity or low density of the population (Beale, 1964, pp. 268-269; Browder, 1963, p. 34; Council of Europe, 1968, Vol. 1, p. 40). However, areas of the nature just described are seldom the first to experience population decreases when a long period of population decline gets underway. The forces effecting the changes resulting in population losses take time to diffuse to the secluded places, i.e., measured from the urban locations. A geographer studying rural depopulation in Ontario, Canada maintains

> Depopulation started with the migration of the nonfarm population from townships where village functions could no longer compete with the spread of the city idea and with the extension of city services. . . . the regions which first declined were those that first felt the impact of city institutions (Watson, 1947, p. 148). . . . in the Niagara Peninsula it seems clear that first the villages declined then farms were abandoned (Watson, 1947, p. 150).

In the states of Vermont and New Hampshire, the earliest loss of population in the late 18th and 19th centuries took place in the southern rural areas nearest to the largest towns and cities, e.g., Manchester and Portsmouth, and of course, adjacent to the more urbanized southern part of the New England region (Wilson, 1936, p. 21). Near Montreal counties lost population then regained it because of industrialization (Biays, 1968, p. 318). The same occurrence was true in England. In Victorian England in the rural localities near the cities, the losses were soon more than overcome through overspill from the cities (Lawton, 1967, pp. 241-246). In like manner similar areas in Vermont and New Hampshire revealed increases in population through most of the subsequent decades of the 19th century as the depopulation pattern spread north and became generally more ubiquitous during the 19th century (Wilson, 1936, pp. 49 and 105).

Similar spatial developments and patterns can be seen at the national level, e.g., the United States. Zelinsky has observed:

> . . . . Beginning in a large scale fashion by the middle of the nineteenth century in the northeastern region which can fittingly be called the Core Area of Anglo-America, rapid agricultural and industrial progress led to rural attrition; and soon after a concentric crest and trough of rural maximum and decline began to pulsate steadily outward toward the far corners of the country (Zelinsky, 1962, p. 522).

The above quote is an apt description of the relative spatial movement of the depopulation phenomenon; however, more needs to be added about the coinciding role of urbanization. The nation was being increasingly urbanized during the 1800s. If the above theory, namely that the rural areas nearest an urban place are the first to experience depopulation but shortly thereafter have population gains or little population loss is correct, then the dominance of the northeastern urban area of the United States could explain the beginning of rural depopulation in the Northeast. Therefore, during the initial stages of population declines the places situated nearest to the urban concentration experience rural, and particularly nonfarm population decreases; however, there is evidence, for example in Quebec, where rural population losses are comparatively more recent, that there is a rapid spread of urbanization forces via the service industries to the villates (Biays, 1968, pp. 315-316). A significant portion of the rural nonfarm population in the beginning of the depopulation process retain their numbers less well than the agricultural areas (Keyfitz, 1962, p. 311).

Farm population decreases in the mid and last phases. During the first phases of rural depopulation process in a region, the state of agriculture and its required physical resources are of secondary importance in causing depopulation, but become increasingly important during the middle and concluding phases of the population decline. The agricultural population suffers the largest relative decline which continues over a long period of time. The generally long and persistent nature of the losses is characteristic of farm depopulation. The lag of the agricultural population's reaction to the assumed urban derived force(s) causing population declines is finally overcome and agricultural depopulation continues essentially unabated, increasingly feeding upon itself, i.e., initial population losses become an additional cause of population declines.

Because of the large percent of the rural population which was historically occupied by agriculture, the decline of the farm population is a very important phenomenon to understand as many of the changes in the countryside can be grasped only if this significant "transition" is more fully known. A noted Canadian writer reported ". . . the decrease in rural population is chiefly due to the removal from the country community of farmers' households" (MacDougall, 1913, p. 68). In France depopulation occurred in all of the mainly agricultural departments from 1851 to the 1960s. One review of the 1960s population data of France reveals that the larger the proportion of the population dependent on agriculture in rural political divisions, the greater the population decline, except where the percentage of population dependent on farming falls below 40 percent (Council of

Europe, 1968, Vol. 1, pp. 15-16). Such threshold values could prove useful to the planning and implementation of rural development programs. In England in the 1890s, thirty or forty years after rural population began to decline, outmigration was ". . . observed in every agricultural district that lies remote from towns" (Graham, 1892, p. 9).

Type of farming. Although there are areal variations in the quantity of agricultural population losses, the literature contains contradictory findings as to areal associations with type of farming. Longstaff (1893) found that localities of varying types of agriculture were affected about the same. Another writer, also studying England, determined that the crop growing areas of the eastern parts suffered the largest declines (Roxby, 1912, p. 184). Some of the difference in interpretation may be according to whether the decrease in population is seen as changes in total numbers of population or net migration loss (Lawton, 1967, p. 247). Some types of farming appear to retain farm population more adequately than others, for example, dairy, fruit, and tobacco farming (Bracy, 1958, p. 389; Graham, 1892, p. 8; Watson, 1947, p. 146). A good illustration of the retention of farm people in tobacco farming is--because it is difficult to mechanize--the State of North Carolina which in 1960 led all states in total farm population (Hathaway, 1968, p. 27). Also, changes in type of farming may result in a loss of farm population (Watson, 1947, p. 150). The above tends to suggest that the more specialized the farming the less the loss in farm population, but there are exceptions. In France, crops requiring many workers, e.g., flax, hemp, silk, and vine crops contracted (Pinchemel, 1969, p. 114) as the cities took rural workers for the industries. However, in Ontario, Canada the ". . . general farming districts depopulation has been prolonged" (Watson, 1947, p. 146).

Commercial farming. Another important characteristic of farming seemingly pertinent to all types of farming is the degree of commercialization. For the Canadian prairies, a study on farm depopulation and the economic conditions of agriculture revealed certain size commercial farms measured by the value of products sold, specifically those so-called farms, "small commercial farms" and "small scale farms," were the best predictors of agricultural depopulation. The simple correlations respectively were: .648 and .647. These two independent variables considered together in a multiple regression equation produced a coefficient of multiple determination or R^2 of .577. Interestingly, the inclusion of the two most additionally relevant variables out of the fifteen tested indicators of economic conditions on farms raised the R^2 to only .618 (Szabo, 1971, pp. 28, 33, 35, and 39). The extent to which farms are tied into markets is a clue to the preservation of farms and the farm population. In addition, the measures of commercialization are presumed to be more adequate measures of the significance of farm size relative to the success of farming than is physical size of farms, e.g., average size of farms in acres. The association of agricultural depopulation with average size of farm, i.e., the acres of land within one farm unit, is unclear because of the contradictory findings of many studies done on various geographical and administrative levels.

Traditional farming. In the United States traditional agriculture was primarily subsistence. Actually more than vestiges of the traditional agriculture lasted to a very recent time, i.e., post World War II; consequently any historical study of agricultural population declines must consider the relative strength, continuance, and areal variation of the "old agriculture" during the different time periods. It is quite conceivable that where commercial agriculture is strong, the present greater integration of all persons within the market economy disallows maintenance of the traditional agriculture. In other places part-time farming may be an attempt to revitalize the old agricultural ideals or to find a "refuge" (Rohrer and Douglas, 1969). Watson (1947, p. 145) is of the opinion however, that ". . . where agriculture is developed on a highly commercial basis . . . (it) dispenses with homesteading and part-time farming," especially when urbanization competes for rural labor.

The precedence of situation. Although both the static and dynamic states of agriculture are closely related to farm population decreases, the role of situation takes precedence. The degree of agricultural orientation and comparative strength of the stable and changing characteristics of agriculture in an area is tempered by its relative location to the nearest and most influential urban place. In a substantial study of rural depopulation primarily in the last half of the 19th century in England and Wales, the evidence provided lends support to the above generalizations and reveals, ". . . distance from growth points was more important than the quality of soil or the type of farming in accounting for variations in the intensity or duration of loss of population" (Lawton, 1967, p. 243).

The major importance of distance in explaining population decreases may be seen also in regard to mountains whose physical makeup is such to impede transportation and communication; thus, the "effective" distances are greatly increased in such areas. Consequently, there is some degree of association of rural depopulation with selected elements of physical geography. In France it is said,

> Rural depopulation has been greatly influenced by environmental conditions. Impoverished mountain regions and those with poor soil have suffered the greatest depopulation (Pinchemel, 1969, p. 117).

Many studies have documented the tendency of mountain areas to lose population. Several examples can be cited which serve to illustrate the differences and similarities of mountain depopulation. In Switzerland, upland areas belong to two mountainous regions, the Alps and the Jura. The Jura have not experienced much population loss because the early local industrialization has acted to retain the people. In contrast, the Alps have had many townships losing persons for the last hundred years, except where tourism and locations on railroads and highways are important. Depopulation is to be noticed more as a local phenomenon, rather than a general one as farms are abandoned and villages slowly decline. Nevertheless, a repopulation movement is nearly equivalent in strength as small industries and tourism are introduced in some localities (Council of Europe, 1968, Vol. 1, p. 43; Perret, 1960, p. 287). Therefore, probably on a local basis in mountainous regions as much diversity exists as to whether the populations are increasing or decreasin-, if not more so, than in any of the other kinds of physiographic regions. Yet, some additional generalizations appear to be possible.

Some simplification of the seemingly local diversity in the population change situation is possible through viewing the land in collective categories based upon elevation. Mountain zones of depopulation can be visualized (Pinchemel, 1969, p. 117). Generalization may be taken from events in Italy and France. The spatial aspect of the mountain depopulation process may be described as the gradual movement away from the higher elevations, down from mountains to hills, and then to plains (Toniolo, 1937, p. 477). However, the localities of moderate altitude, defined as below 1,000 meters appear to have the least attractions, and continuously lose people. "The middle altitudinal zones have in fact none of the advantages of the plains and none of the assets of high mountains." In the high mountain areas, settlements that have obtained some tourist industry, have survived. Valleys decline in population if the economy is entirely an agricultural one, but show strong growth if industries exist or are introduced (Pinchemel, 1969, p. 117). In respect to the relative time that these losses in population take place in mountainous regions some knowledge may be gained from the English and Welsh experience with rural depopulation during the latter half of the 19th century. In the upland portions of Mid-Wales, southwestern England including the Cornwall Peninsula, and the northern Pennines, there ensued "constant loss" and severe depopulation although moderate population densities prevailed. These upland areas constituted about one half of the total area having net outmigration exceeding natural gain (Lawton, 1967, pp. 239 and 242-244). Mountain regions tend to have comparatively longer periods of population decline of relatively high rates regardless of the existing population densities.

The Depopulation Syndrome: Signs, Symptoms, and Characteristics

A few omens of depopulation can be stated; if these are known and sufficiently recognized in an area or place, actions may be taken in time to reduce net outmigration of persons, providing this is the desire of the local citizens and it is in the interest of the general public and the welfare of the nation. As has been indicated in the previous discussion, there are special recognizable geographical characteristics of regions, areas, localities, and places which are prone to net outmigration, and subsequent rural depopulation. Presented below are some additional manifestations of pre-depopulation conditions or precursors of depopulation.

Density, overpopulation, and optimum population. Population density and its moderate quality in the uplands of England and Wales did not preclude the continuous significant depopulation of these highlands during the last half of the 19th century. Density, of course, is very much a relative term, difficult to use comparatively, and is not very meaningful when based only upon physical area. Zelinsky has suggested the substitution of the "population/resource ratio"--"the relationship between the size and the technical adequacy of a population on the one hand and the quantity and quality of terrestrial resources on the other" (Zelinsky, 1966, p. 102). By using resources as a point of reference some more effective meaning can be obtained from density and the term "overpopulation," a condition said to be ". . . often the precursor of depopulation in the strict sense of the term" (Toniolo, 1937, p. 476).

Overpopulation in respect to a static view can be defined in terms of "optimum population," a number when exceeded creates a situation of overpopulation. The optimum population may be interpreted as the point of maximum return in relation to any or all of the following: land, labor, capital, economic return, food, income, life expectancy, general welfare, standard of living, military power, full employment, and social advantages. Ordinarily, however, "the optimum population of any area is the number of people which, in the given natural, cultural, and social environment, produces the maximum economic return" (Petersen, 1961, pp. 526-530; Pressat, 1971, p. 107). Finally, some overpopulation is called "technological overpopulation," e.g., when machinery introduced in agriculture results in underemployment and unemployment (Pinchemel, 1969, p. 114). Areas exemplify various types of overpopulation. The revealing question is what kinds of overpopulation are particularly indicative of potential depopulation tendencies?

Unemployment or underemployment is one of the best indicators of overpopulation, but unfortunately, the data for farm population is incomplete and unreliable because of the nature of the agricultural business, i.e., persons may survive on farms via "income in kind" produced on the farms. Undesirable employment conditions exist where technological overpopulation has occurred in agriculture. Farming tends to become more extensive, thus using still fewer workers

(Toniolo, 1937, p. 474). As might be expected the farm laborers decline significantly and are the first to be affected by mechanization of the agricultural operations (Lawton, 1967, pp. 246-249; Ogle, 1889, pp. 222-223; Pinchemel, 1969, p. 116).

Mechanization and farm consolidation. Once machinery is incorporated into the farm system's operations, farms need to be enlarged for the efficient use and achievement of economies of scale in the use of this expensive capital investment. Although mechanization rates and levels vary considerably by type of farming, they affect the rate of farm consolidation which is an indication of subsequent agricultural depopulation as some farm people will sell their land to an adjoining farmer and reserve use or keep property ownership of the farm house and its lot. Both the degree of mechanization and farm consolidation vary according to the type of farming. Because the types of farming best fitted to a region depend significantly upon a region's particular mix of resources, it is to be expected that farm depopulation, a nationally wide phenomenon, examplifies great variations in the rate and amount of the agricultural population loss within regions and type of farming areas (Browder, 1963, p. 31). In south central Idaho which has two areas with quite different histories of rural farm population decreases, one area's irrigation costs prohibit the acceptance of the additional costs of farm consolidation (Bollinger, 1972, pp. 570-571).

Community tensions and social disruption. One study fittingly sums up the "atmosphere" permeating a community undergoing the various processes leading to depopulation, including mechanization and consolidation, as "tensions" (Rundblad, 1957, p. 184). Perhaps because of the use of machinery, farming is increasingly done alone and with less social interaction among farmers (Bausman, 1904, pp. 278-279). Increased dependence on self in farming may mean fewer community duties and "chores" done together. The additional costs of machinery and more land gives a sense of financial insecurity. Community cooperative action dissipates, e.g., in schools and road maintenance. ". . . . The break-down of relations inside the community itself (is) followed by an increased opposition to the outside world" (Rundblad, 1957, pp. 187-190).

Social isolation and the need of alternative employment. The inward-looking nature of some of the communities that are destined to be affected by the depopulation process causes an isolation greater than that of physical distance. This attitudinal condition is further exasperated by a serious lack of alternative jobs (Bracey, 1958, pp. 387-388). Some areas are more fortunate in that part-time jobs are available within commuting distance; thus, a healthy exchange of ideas with outsiders is facilitated. Mountain areas especially have an absence of supplementary industries, e.g., forestry may not even be developed in a primarily agricultural area (Toniolo, 1937, p. 477). There is a need for a wider selection of work than that provided by primary activities, e.g., farming, lumbering, and mining, as these industries may decline at the same time. Simultaneous and serious declines in mining and agriculture were experienced in Wales in the late 1800s (Great Britain Ministry, 1964, p. 3) and in the northern

Appalachian region of the United States during 1940 to 1960. In the latter, changes in total employment ranged primarily in agriculture from one third to two thirds decreases and in mining from one half to over three fourths decreases (Royen and Moryadas, 1966, pp. 187-190). In addition, profits in primary and resource extractive activities and in farm products tend to be among the lowest because the site of extraction frequently does not share in the returns of processing. The most common factor of areas that will suffer depopulation is declining employment opportunities (Saville, 1957, p. 7). The loss of economic activities in the villages and some towns especially restricts the potential choices of occupation in the countryside.

Selectivity of persons in outmigration. The characteristics of a rural area prone to outmigration and depopulation particularly affect certain components of the areas' population and this is particularly true because of the few choices in employment. Career opportunities are limited for young people. The highly educated must move away to use their knowledge and skills lucratively (Great Britain Ministry, 1964, pp. 2-4). But, without doubt, if we assume ". . . the possibility of earning more money is generally pre-eminent among the several operating motives" (Thomlinson, 1965, p. 225), and ". . . we consider job opportunities to be the driving mechanism of migration . . ." (Beshers, 1967, p. 142), a rural area having a predisposition for population loss can be expected to have an outmigration which is predominantly female.

The feminine preponderance within migrants from rural areas is to be expected as part of the overall tendencies in human migration: the female is more migratory than the male in rural-urban migration and short-distance moves (Ravenstein, 1885, pp. 196-198; Thomlinson, 1965, p. 227). Nevertheless, the greater loss of females from the countryside can be much more fully explained by the fact, given the traditional sex selectivity of jobs, that fewer positions are available in the rural areas for women than men; thus, a high sex ratio is characteristic and ". . . is the most striking demographic consequence of rural depopulation." The push or expulsion factor of declining employment opportunities appears to affect women more than men in a rural community predestined to experience depopulation (Saville, 1957, pp. 32-2).

The female portion of the population is composed of several groups, each exemplifying somewhat different migrational behaviors. Young single girls commonly leave the rural districts before the boys (Rundblad, 1957, p. 186). Historically, the life of a "country woman" was a very difficult one (Council of Europe, 1968, p. 64). The inadequacy of social, cultural, and domestic amenities and services in rural areas is believed to have influenced many women to leave rural life in Austria, Turkey, England, and Wales (Council of Europe, 1968, pp. 56 and 86; Saville, 1957, p. 36). The single girl would be somewhat more motivated by the desire to find employment than the married woman; thus, when explanations are given for outmigration based upon employment desires, note should be made of an individual's marital status. A significant amount of internal migration in the United States is associated with individuals as unemployed members of a family and change in marital status (Petersen, 1968, p. 288; Rossi, 1955).

Farm land ownership. An interesting question which apparently no one has asked while studying decreasing rural populations is whether the traditional female sway over outmigration from the farms and villages within a nation is associated with land tenure. In farming it is most often a son who gains ownership of the family farm. This is not a question which will be addressed in this study, but is stated here for the implications which perhaps could make the results of this study more meaningful.

The changes in land ownership can be indicators of eventual depopulation. The question needs to be asked, as to who are the new owners? Are they nearby residents? Frequently, realtors are interested in out-of-state buyers or urban buyers who either have the ready cash or sufficient credit to meet the listed price of the rural property. Many of these buyers are not interested in a farm for a permanent residence, but use it for speculative purposes, hunting, or as a summer retreat. Therefore, often the land is kept from the local population who needs its resources because they are not able financially to pay a high price for the property. Farmers sometimes rent the land, but this is a less satisfactory way to the land resources as farmers are reluctant to use lime and proper fertilization when the property is not theirs and they might not have the use of the land the following year. Thus, the yields from such land is much less than could be under a farmer's ownership. Absentee owners with nonagricultural objectives may allow the cultivable fields to become brushwood.

The passing of land into the hands of absentee owners is a definite characteristic of areas on the brink of depopulation or already encountering population losses; and, such an occurrence and state can be regarded as a "colonial phenomenon" (Council of Europe, 1968, p. 105). The above situation is said to be common in France. One of the best known and documented histories of absentee ownership was in Ireland where Englishmen owned estates. Hart (1963) has written of other similar tendencies in Northeastern United States. Estate and recreational farms are a conspicuous feature of the rural landscape of Megalopolis (Gottman, 1964, pp. 310-319), and the spread of these land uses into the Appalachians displaces the farm population.

Within a region or area, however, there may be distinct differences in wealth of the indigenous farm population; some of this variation is associated with the settlement decisions of their ancestors a few of whom chose more favorable sites than did others (Pearson, 1935, p. 214). The farms of the fertile and level plains and valleys contrast with the farms of the less fertile soils of the steep, irregularly shaped, and small fields of the mountains. Wherever financial differentials exist among the farm population of an area, unless there is some governmental attempt to correct the difference in resources, e.g., in special tax provisions based upon value of agricultural production rather than on potential nonagricultural value--a new movement in the United States to preserve open space--one may expect local depopulation to take place in the hill lands as the good plains and valley sites have standards of economic success, the break even points, higher than the capabilities of the physically disadvantaged lands.

The Basic Causes of Depopulation

The Major Demographic Aspects

Depopulation may be viewed geographically as the removal of people, either through natural decrease and/or outmigration, from any place or area during any given time. Demographically speaking, depopulation is made up of three basic demographic processes: births, deaths, and migration, through which population decline occurs. To understand depopulation it is necessary to contemplate carefully the "interaction pattern" among these demographic processes (Stockwell, 1969, p. 555). Births and deaths may be regarded aggregately. A natural change figure results. The type of natural change relevant to depopulation is natural decrease or "biological dissolution," previously associated with some U.S. cities (Dorn, 1939), but comparatively a new and rapidly spreading phenomenon in the rural United States (Beale, 1969). Natural decrease in a rural population is a development nearly unprecedented in modern times, and it has affected particularly the farm population, that has ordinarily had high fertility and birth rates. This reversal of an old traditional demographic truism has been brought about by the strong action of a second major demographic process, and that is migration.

Outmigration from the farms and rural areas of the United States has continued over a relatively long time. It took place especially in the East, even as settlement of the interior of the country, commonly called the West, was uppermost in the minds of Americans. "Once emigration has begun from whatever cause, factors are introduced which tend to maintain the movement" (Bracey, 1958, p. 390). Consequently, several generations of rural Americans and especially the farm population have had their group replacement capabilities lowered significantly by outmigration, giving evidence of its special selectivity of the younger age groups with the greatest reproduction potential (Beale, 1964, pp. 269-271). The resident populations of many rural areas have had their age structures altered by the aging of the population through the greater emigration of the young (Bracey, 1958, p. 389) and through the loss of the children these people had elsewhere. Eventually outmigration, in addition to causing the actual loss of population from an area, if at high enough level and rate, will be often the primary demographic reason for the occurrence of natural decrease. The ultimate magnitudes of depopulation are reached when both natural decrease and net outmigration are taking place at a high rate in an area, resulting in an absolute loss of population.

Contributing Forces and a Theory

A number of continuous cultural forces with economic, social, and political facets feed depopulation. Considered here are the most general and universal of the contributing forces.

A few conjectures obtained through a temporal approach and listed chronologically give support and guidance to the organization of the remaining part of the literature survey. This is in part an exploratory study and the generalities and general hypotheses given should not be regarded as absolutes, but are some conclusions, drawn by this writer from his studies, in need of further study and testing. The major factors that attend and affect rural and agricultural depopulation are thought to be as follows:

(1) To be susceptable to moving out of an area, a rural or farm population first has to know what its relative welfare is, and the clues to this come from contacts with outsiders, either through friends, relatives, strangers, mass communications, and/or travel.

> The process of rural depopulation and its variations in time and space may be thought of as the spread of an idea, namely the idea to leave isolated, low income areas for large villages, towns and cities (Norling, 1960, p. 233; Gade, 1970, p. 77).

(2) The pull forces operate as the major causes of outmigration in the beginning, affecting primarily the members of a population who are dissatisfied and have high expectations.

(3) After outmigration has occurred for a few years the various types of conditions, e.g., environmental and socioeconomic, are established; thus, the push forces eventually play the major role in depopulation.

As outmigration is the major demographic process bringing about depopulation, some migration theories may be supportive of the chronologically determined importance of pull and push factors. Much of migration occurs by stages with only short distances involved. The areas immediately adjacent to a significantly growing city are first affected by outmigration to the city, and a shifting of rural population evolves inward toward the city, ". . . until the attractive force of one of our rapidly growing cities makes its influence felt, step by step, to the most remote corner . . ." (Ravenstein, 1885, pp. 198-199). One inference is that the pull forces of the city initiate the outmigration and dominate the first phases of the process. An author in historical demography has written:

> Some evidence has been found that suggests that "push" factors (that is, poor conditions at the place of origin) play a larger role in long-distance migration than in short-distance migration, while "pull" factors more particularly affect the short-distance movements (Hollingsworth, 1969, p. 4).

Thus, it seems that pull forces initiate a period of outmigration as the early movements primarily are over short distances that are more associated with the pull forces. Push factors, however, tend to bring about migrations over longer distances than do the pull For example, the Black migration from the Deep South to Northern cities was caused primarily by push factors. Push forces vary in strength for several reasons:

(1) Unlike pull forces which come from various places, push forces come from really only one location, the residence and community of the migrant.

(2) The interactions of the earlier population losses with the residential environment result in a particular set of conditions for any given area.

The push forces affect the source populations differently, culminating in different rates of outmigration from area to area. The contradictory findings on the selectivity of migration can be explained by studying the diverse conditions of the home areas.

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If there exists more variation in the rural or farm population losses in the study area during the mid 1900s than the late 1800s and the first two decades of the 1900s, this would tend to substantiate the proposed theory: that after the pull forces have dominated for awhile, the push forces exert the predominate influence, and their variant strength is revealed in the differential population loss rates. A major study of rural depopulation in England and Wales revealed that during the first half of the population losses from the countryside, the total decreases were ". . . remarkably general and constant throughout the period 1841-1901 . . ." (Lawton, 1967, p. 229). As England and Wales are about the same size in area as the largest states of the United States east of the Mississippi River, the nature of rural population declines there perhaps are similar to those of a large or moderately-sized state in the eastern United States.

Geographical Level of Analysis

If the level of analysis is carried out on smaller administrative units than the state, e.g., counties, more variation in the dependent variables is to be expected. An analysis by township level would reveal generally more variation in population change than a study done of counties. Consequently, in analyzing depopulation it is most important to remember that generalizations from one level of analysis cannot be safely applied to another level without considerable testing. An interesting effect of differences in area size and length of time on the basic causes of depopulation is summed up as follows: "The smaller the region and the shorter the time-span, the

more migration will preponderate over natural population changes" (Hollingsworth, 1969, p. 2).

The demographer's definition of migration relates to the changing of a person's usual residence for a considerable length of time, while traversing a governmental boundary in the process (Thomlinson, 1965, p. 211). The smaller the governmental units, the easier it is to cross a boundary, and thus be classified as a migrant. Yet, another aspect of an analysis of rural population decreases that is closely associated with size of the areal unit of observation is the general nature of the contributing (explanatory) process. Emphasis on small area analysis, e.g., by county or township, means the "push factors" would tend to be more important in explanations of migration because the major spatial variations, i.e., differing conditions from place to place, would be revealed. Processes work differently at the various areal levels (Sly, 1971, p. 29). Therefore, generalizations on migration and thus depopulation must be made in reference to spatial units or administrative areas.

Summation of the Temporal Importance of Pull and Push Forces

In summary, the contributing processes of rural and farm depopulation are seen as belonging primarily to one of two large, encompassing, and universal processes: the pull and the push developments. Pull forces originate at the place of destination and push forces operate at the place of departure. Although factors influencing outmigration and depopulation are considered in this study as either of one or the other of the basic types, note needs to be taken that

> some variables may operate as either push or pull factors: technological changes (the factory system pulling people to cities and the tractor creating a surplus agricultural population pushing people out of rural areas) . . . (Thomlinson, 1965, p. 224; Nelson, 1955, pp. 124-125).

Other examples may be given that seemingly illustrate that pull and push forces are the extremes of the same force, i.e., the presence of a factor at one site and the slight presence or nonpresence of that factor at the other site. Interaction occurs between a pull force and the potential migrant and he reacts according to the environmental elements and conditions of his place of origin, i.e., the push factors. Pull and push forces are rarely the opposites of the other. Pull forces exert the primary influence in the first part of a depopulation era; afterwards the push factors explain most of the population losses. Lastly, the relative importance of pull factors and push factors is related to some degree to the areal level of analysis; and, generalizations about the causes of depopulation need to be made in relation to a kind of area or place.

CHAPTER 3

PROCEDURE OF THE INVESTIGATION: AN APPROACH TO REPRESENTATION AND EXPLANATION OF FARM DEPOPULATION IN THE NORTHERN APPALACHIANS

A Specific Statement of the Problem

There is general recognition that there are now fewer persons on American farms than in the past and that thousands of farm persons have left the farms never to return; however, the magnitude of the farm depopulation and its implications have been only slightly recognized. To some Americans, the farm person is a dispensable individual.

Underlying this presentation is the author's view that increasing the public's awareness of the significant and serious extent of the agricultural population decline necessitates much preparatory research. The whole depopulation phenomenon has been inadequately studied. In addition, the adverse consequences of the farm population decreases are among the most potent reasons for such a topical study, along with public policies which at least until recently either encouraged, or by their omissions, worked in favor of the depopulation of American farms; however, the aspects investigated are more fundamental to the eventual clarification of the entire phenomenon of depopulation. The essence of this study is the exploration of the general nature and causes of agricultural depopulation; the areal and/or spatial patterns of the farm population losses; the relevant systems, types, and resources of agriculture; the areal distributions of agricultural systems, components, and characteristics; and, the latter's associations with the farm population declines. Changes in agriculture have prompted an unknown proportion of persons to leave farming and dissuaded others from staying who would have ordinarily or naturally entered into farming with the inheritance of a farm.

The scope of the analysis thus is primarily limited to the spatial distributions, areal patterns, and interrelationships among selected agricultural variables and farm population changes in the chosen study area, i.e., the northern Appalachians, during the Twentieth Century. Much preferred is the analysis of the farm population situation within a region as a greater depth of understanding and more plausible explanations can be obtained in a more geographically circumscribed area.

Farm Population; Choice of the Dependent Variable

The measure selected to represent farm depopulation, i.e., the dependent variable, equals the percentage a county's farm population is of an earlier time. The superiority of this measure to potentially other useful variables is that aggregation of the total population situation is achieved, taking into consideration effects of migration, deaths, births, and adoptions. Thus, the overall demographic circumstances of the population living on farms at one time can be compared to that of another time. More succinctly, the facts desired to represent the problem are data revealing whether the farm population of the Region's counties had individually declined, and if so, by how much.

Definitions and Criteria of Population Censuses

The farm population is defined for purposes of the U.S. censuses of population as that population living on farms (Truesdell, 1960, p. 1). Whether an individual residing on a farm or members of a so-called farm family qualify as persons engaged in agriculture is not easily determined.

Prior to 1960 farm residence was primarily resolved by the answer to a subjective question generally referring to whether the house was sited on a farm or ranch--the answer to which the same enumerator for the censuses of agriculture and population often supplied (Shryock, Siegel, and Associates, 1973, p. 171). Before 1960, "no specific criteria of acreage operated or value of products sold from a place were used to classify farm population." The pre-1960 method of determining farm population is believed to adequately illustrate the conditions existing in the years of 1940 and earlier, when subsistence farming was widely prevalent (Banks, Beale, and Bowles, 1963, pp. 10-11).

A major reason for using a new, objective, and more specific definition in 1960 was to produce a definition of farm residence nearly consistent with the new definition of a farm begun in the Census of Agriculture of 1959. A somewhat condensed version of the definition of a farm than that used in the census of agriculture of 1959 was necessary for enumerating the farm population.

> In the 1960 census, the farm population includes persons living in rural territory on places of 10 or more acres from which sales of farm products amounted to $50 or more in 1959 or on places of less than 10 acres from which sales of farm products amounted to $250 or more in 1959 (U.S. Census of Population, 1960, Vol. I, Part I, p. xxxvii).

Surprisingly, before 1960 ". . . no definition of a farm was provided in the census of population per se," although the farm population has primarily always been defined as the population living on farms (Shryock et al., 1973, p. 171). The essence and major result of the change was ". . . to exclude from the farm population persons living on places considered farms by the occupants but from which agricultural products are not sold or from which sales are below the specified minimum" (U.S. Census of Population, 1960, Vol. I, Part 40, p. xv). In other words some persons not engaged in commercial farming, as defined, but who lived on "farms" were excluded from the census of farm population. In addition, farm population in urban areas were not counted. Tests of the effects of the definitional changes revealed that the 1960 farm population was reduced by around 21 percent compared to the count which would have been obtained using the old definition (U.S. Census of Population, 1960, Vol. 1, Part 40, p. xv). Thus in explaining farm population change in the 1950s this reduction in numbers of farm persons "on paper" must be noted.

Major changes continue in agriculture; and, as agriculture becomes more characterized by commercial, agribusiness, or organic enterprises, the types of statistics needed for manufacturers, traders, buyers, investors, and other businesses and governmental concerns will change as in the past, inducing changes in the minimum criteria to represent a farm. The persons counted as farm population will correspondingly change as long as the definition of farm population is associated with the definition of a farm. Nevertheless, in 1970 the same basic definition of a farm as given above formed the basis of the census definition of the farm population (Banks and Beale, 1973, p. 7; County and City Data Book, 1972, p. L).

The new standards implemented in the census helped to better identify those persons who were closely associated with agriculture. The major changes in the definitions of farm and the farm population in 1959 and 1960 were prompted by the increasing numbers of people who resided in the rural and open country on former farms but whose livelihood no longer depended directly upon agriculture. From 1920 when the farm population was first listed separately, as more farm residents were drawn into nonagricultural employment, the assumption that the farm population matched the agricultural population became less correct (Shryock et al., 1973, p. 171). Presently, the farm population, as defined by the Census, is not composed entirely of those individuals economically dependent upon agriculture because some of the persons living on farms are part-time farmers and their dependents, members of farm operators' families living on the farm who work in nonagricultural occupations, or farm wage workers and their families who earn some of their annual income in nonfarm occupations. These groups at least have some connection to agriculture; whereas, the people who live on farms but earn all or nearly all their living in nonagricultural occupations, who have mostly been discounted as farm population, have no other association to agriculture except they live on a farm. As agricultural operations have been abandoned on many farms, nonagricultural people have frequently rented farm houses and houses on the farms formerly the residences of farm laborers, or tenants and blurred the earlier close association between farm residence and economic dependency upon agriculture.

Some changes in definitional criteria, and instructions to the enumerators starting in 1950 tightened the relationship between the counted "farm population" and their association with agriculture. Persons on farms who paid cash rent for their house and yard only were to be classified as nonfarm. Also, persons residing in housing of institutions, summer camps, motels, and tourist camps located in the open country were to be regarded as nonfarm. With these changes about 8 percent fewer persons were classified as farm residents than would have been under the former criteria (Shryock et al., 1973, p. 171). An additional reduction in the farm population occurred in both the 1960 and 1970 censuses when unmarried farm youths enrolled in colleges away from home were enumerated as residents of the communities where they were attending college (Banks et al., 1963, p. 10; Banks and Beale, 1973, p. 7).

The Census continues to rely on the concepts of farm and farm residence. There have been in recent censuses of population major changes in the criteria for the enumeration of farm persons which have generally made agricultural relationships more characteristic of the designated farm population. A 1966 Census study showed that nearly 40 percent of the employed farm residents worked in nonagricultural activities, but the proportion that such economic pursuits contributed to these farm persons' total livelihood was not reported. Although many farm residents have had some ties to agriculture, the results of the 1960 Census, even with changes in the farm population criteria, displayed a large number of farm families who were not primarily dependent upon agriculture (Shryock et al., 1973, pp. 173-174). Analysis of the percents of farm operators working off the farm data from 1939, 1949, and 1969 for a minimum number of days helped to counteract the nonagricultural aspects of the farm population data and resulted in a relative assessment of the role of nonfarm employment in farm depopulation.

It is not the writer's intention to suggest that the farm population should be completely or primarily dependent upon agriculture, although if such data were available, the relationships between population and agricultural changes found in this study would be more pronounced. For national policy development, state planning, and the public's welfare, however, the specification of the relative degree of dependence upon agriculture would greatly aid the formation of governmental programs and the enactment of legislation. In fact, regular collections of data on part-time farm persons' characteristics would aid in learning much about persons partially dependent upon agricultural activities.

The Quality and Source of Decennial Farm Population Data

Most of the above alterations in the criteria for the census enumeration of the farm population resulted in, from the point of view of this study, a higher quality of dependent variable data available for 1950, 1960, and 1970 than for the earlier years. Thus,

the more farm population change data represented persons primarily engaged in agricultural activities, the stronger were the relationships between the agricultural components and the farm population changes.

The sources of the farm population data were of necessity the various U.S. censuses of population. Although additional sources of data were available, such as the farm population estimates made by the Department of Agriculture since 1923 and also the reports of the Current Population Survey, data were given generally on larger geographical areas than the county level desired for this study.

The 1910 farm population data. Although no direct count of the farm population data was available before 1920, an accounting of the status of agricultural population before and after World War I was important because of the rapid industrialization, mechanization, and technological changes that greatly affected agriculture. Truesdell (1926) had estimated each State's farm population in 1910 by the use of: (1) the number of farms in 1910, (2) the average farm population per farm in 1920, and (3) the change in the average number of persons per family in the rural population between 1910 and 1920. The average change in the size of the rural family was assumed to be representative of change in the average persons per farm, given the assumption of one family per farm. As the farm family was generally larger in 1910, this difference in the rural family size was added to the 1920 farm family size to obtain the 1910 farm family size which was then multiplied by the number of farms in 1910. The 1910 county farm populations for the northern Appalachians were calculated by multiplying the number of farms per county by the state's average population per farm, 4.79 and 4.27, obtained by Truesdell for Pennsylvania and New York, respectively.

The 1920 farm population data. Because the 1920 data by county was unobtainable and comparable data was desirable for the World War I period, averages of the farm population per farm, 4.69 and 4.14, for Pennsylvania and New York, respectively, again were calculated and multiplied with the number of farms found in each county. The 1920 data on farm population by states were not published in the regular volumes of the census of population but appeared in the General Report on Agriculture and in Truesdell's Farm Population of the United States (Shryock et al., 1973, p. 171). Apparently, only special tabulations for the farm population of a few selected counties of the United States were ever published (Truesdell, 1960, p. 2).

The 1930 farm population data. The 1930 U.S. Census data represented the "total rural-farm population" as recorded from the affirmative responses to the question, "Does this family live on a farm?" (Truesdell, 1960, p. 3). The gathering of the data soon after 1929, the beginning of The Great Depression, probably prevented much disturbance of the data by that momentous occurrence. A few counties showed increases in their farm population based upon the estimates of the county farm populations in 1920.

The 1940 farm population data. Again, in 1940 the gathered U.S. Census data pertained to the "total rural-farm population." As ten years previously, either the census respondent and/or the enumerator decided if the residence was located on a farm and in questionable cases the enumerator was guided by the rule stating that places of less than three acres had to "have sold or produced agricultural products of a specific minimum value." These types of places however constituted less than one percent of the total farms before 1945. The 1940 census count of the farm population appeared to represent a "substantial overcount" according to the much larger number of "extra" families per 100 farms (Truesdell, 1960, p. 9).

The 1950 farm population data. As in several of the previous censuses, the rural-farm population was obtained by affirmative answers to a subjective question, "is this house on a farm (or ranch)? (U.S. Census of Population, 1960, Vol. 1, Part 40, p. xv). The definition for the urban population changed in 1950 which resulted in a 12.2 percent decrease in the rural population nationwide (U.S. Census of Population, 1950, Vol. 1, pp. xv and xvii). The rural population is defined as that population which is not urban. As the farm data used applied only to those persons listed as rural, and as the rural population declined because of the change in the definition of urban population, the farm population declined some because of the urban definitional changes. In 1950 the Census adopted the urbanized area and unincorporated place concepts to aid in the count of urban persons (U.S. Census of Population, 1970, Vol. 1, Part A, p. x). Both the rural-farm data under the old and new definitions of urban places were collected and used, the former for comparison with 1940 and the latter as a base of comparison with subsequent counts. The change in the urban definition affected the residence of less than 1 percent of the 1950 farm population determined by the old definition. Some of the more specific criteria for excluding some nonagricultural populations as given above accounted for an undetermined percentage of the farm population decline.

The 1960 farm population data. Dependent variable data for this year represented the rural-farm population and was calculated by the use of the percent the rural-farm population was of the total population as given by the Census. As presented above, stricter criteria were implemented in 1960 than 1950 which resulted in a national decrease in the farm population of about 21 percent from that population expected under the accepted definition of 1950. Some so-called "urban townships" were designated by the Census in Pennsylvania, but apparently the effect on population classification was small (U.S. Census of Population, 1960, Vol. 1, Part 1, p. xix).

The 1970 farm population data. The 1970 farm population as a proportion of the 1960 farm population was obtained from the 1969-70 change data given in the County and City Data Book of 1972. In both the 1960 and 1970 population censuses the farm population data were based upon samples, but these were large; consequently, the contribution of the sample error to the aggregate error in the data was minor at the national level. Nevertheless, "for certain counties and socioeconomic subgroups, the sampling error is fairly appreciable . . ." (Shryock et al., 1973, p. 174).

Overview of the Areal Patterns of Farm Depopulation

The mapping of the representative measures of the relative and absolute magnitudes of a problem is commonly the initial step in geographical analysis of a problem. Once the data are cartographically displayed, gradations in the values of the measured geographical units, e.g., the counties, often reveal contiguous areal units of similar quantities and with much the same geographical characteristics, suggestive of some hypotheses.

Retention of the Farm Population

Cartographic presentation of the proportions of the farm population remaining on the farms for the counties of the Northern Appalachians in the periods of 1910-30, 1940-50, 1950-60, and 1960-70 produced meaningful areal patterns of these population changes (Figures 7, 8, 9, and 10). For comparisons of the more recent time with the situation earlier, it seemed preferable to combine the teen and twenty decades. Because of the emphasis in this study on the declines in the population residing on farms--and as this was the situation in nearly all the Region's counties, for the first three-quarters of the 20th century--the unusual 1930s decade which witnessed a number of counties with increasing numbers of farm persons was not mapped.

Some general findings were revealed for all of the periods. Much variation existed in the county depopulation rates of farms in each of the several periods; however, the largest variation and the highest average losses occurred during the 1950s with the 1960s rates somewhat lower. Often contiguous counties with like values formed several areas that differed very noticeably in the retention

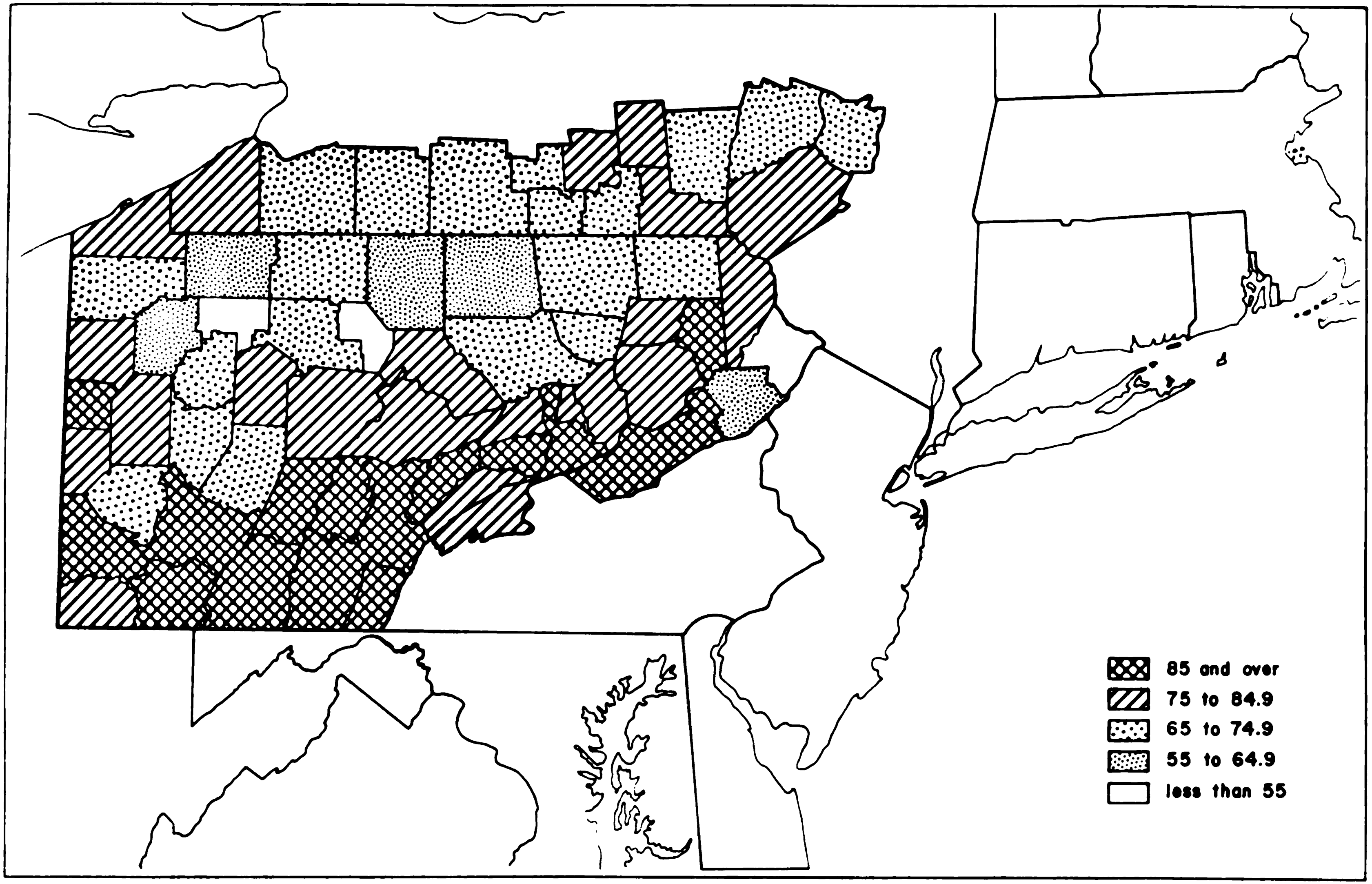

Fig. 7.--Percentage Retention of the Farm Population by County in the Northern Appalachians, 1910 to 1930.

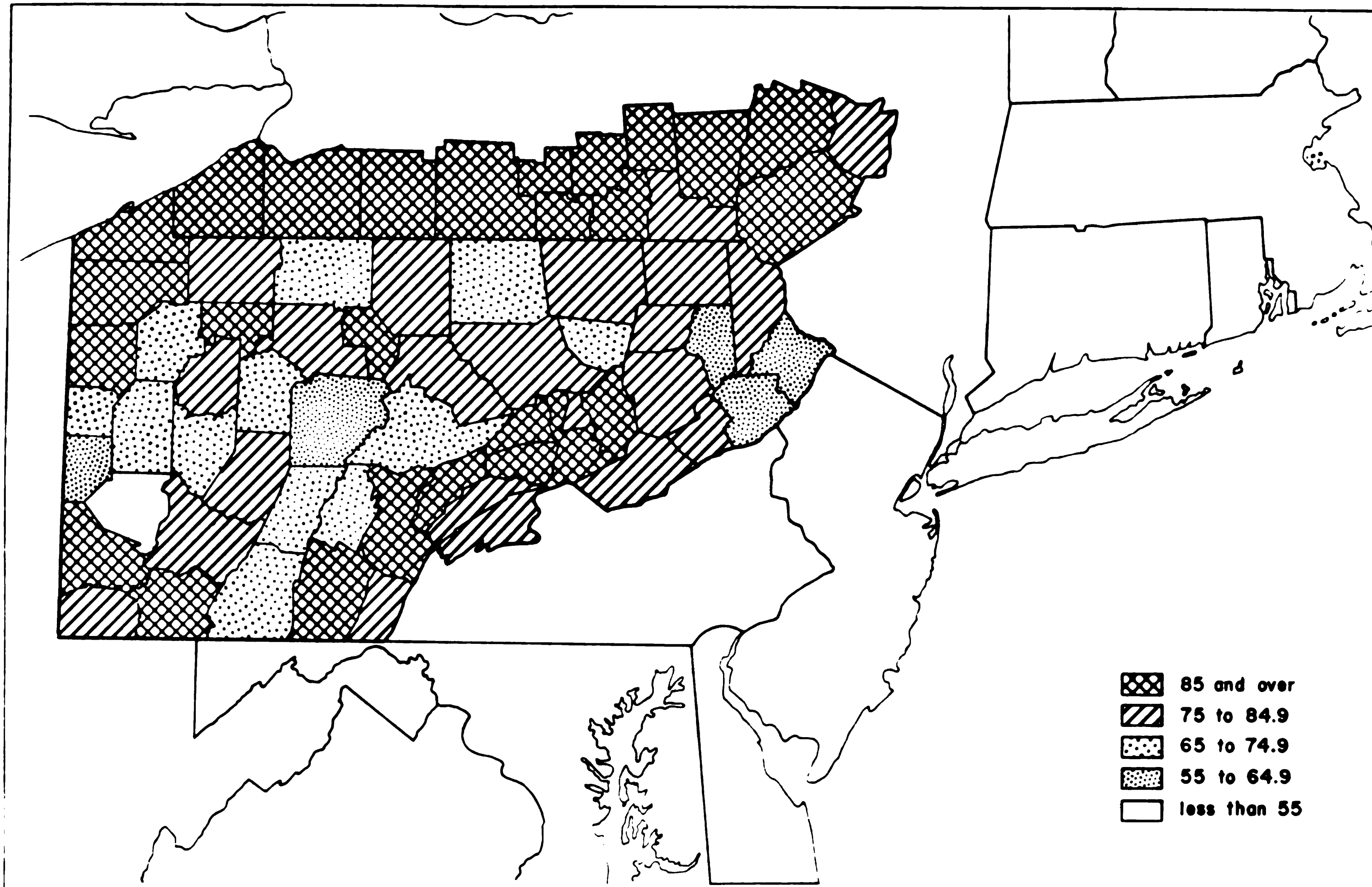

Fig. 8.--Percentage Retention of the Farm Population by County in the Northern Appalachians, 1940 to 1950.

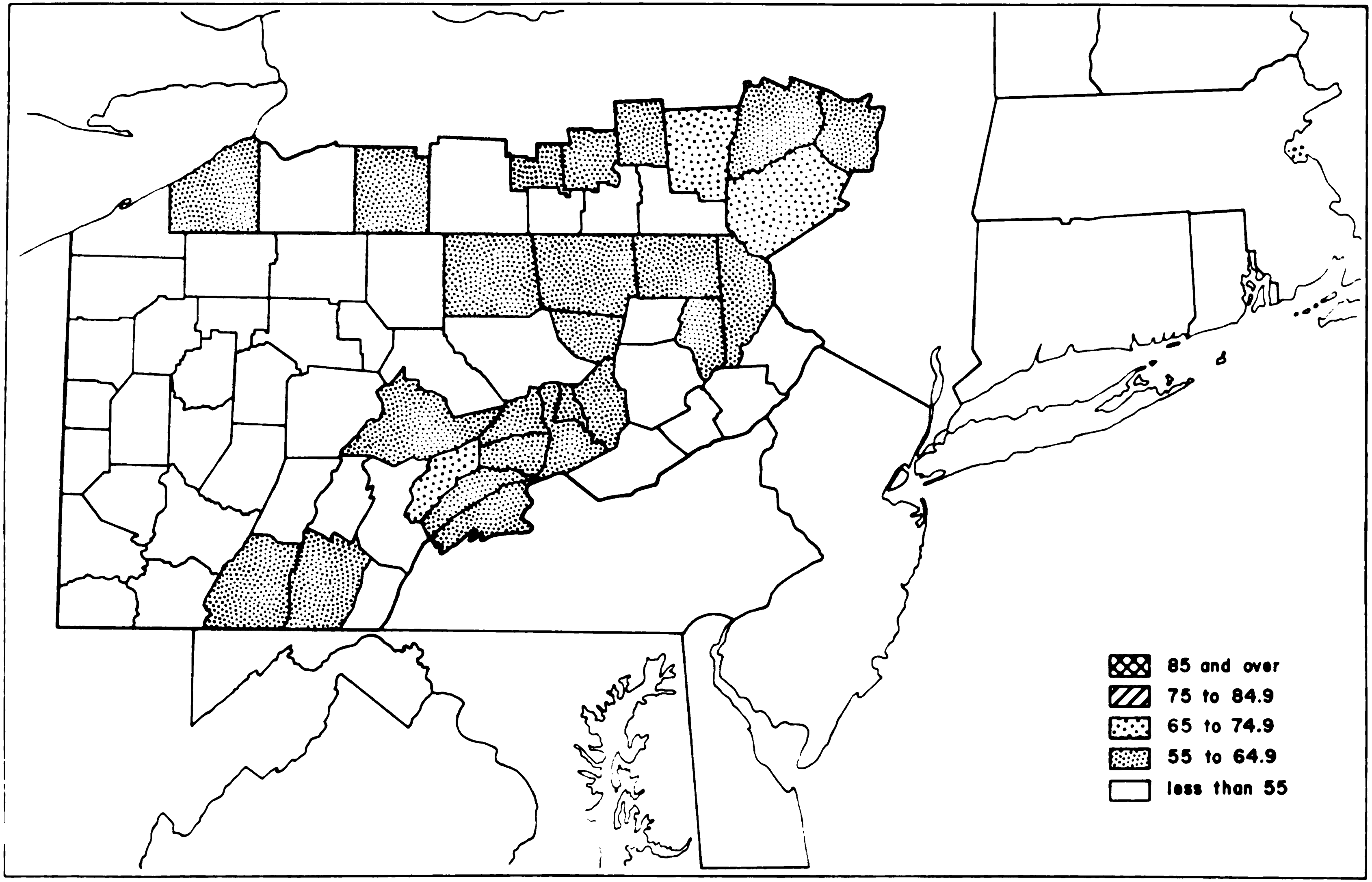

Fig. 9.--Percentage Retention of the Farm Population by County in the Northern Appalachians, 1950 to 1960.

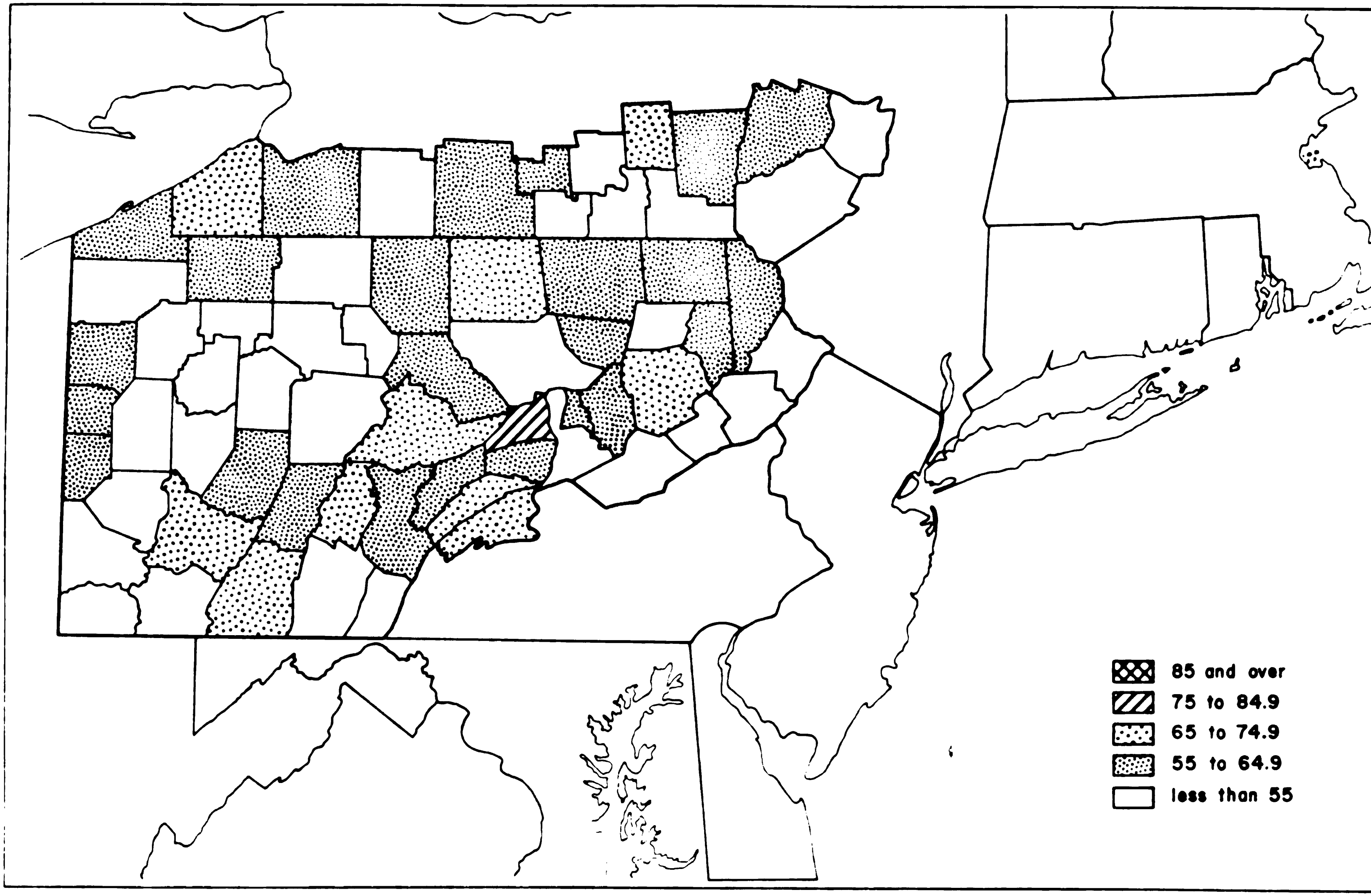

Fig. 10.--Percentage Retention of the Farm Population by County in the Northern Appalachians, 1960 to 1970.

of farm persons. Also, areas usually differed as to when the largest farm population occurred.

Subregions of Prolonged Farm Depopulation

Except for the counties bordering Ohio, Western Pennsylvania has had the most persistent and highest losses. Another area of steadily high rates of farm depopulation coincided with the Pocono highlands in northeastern Pennsylvania. Because of the recurrent low rates of farm population retention in much of the area westward from the Allegheny Front of Pennsylvania, i.e., in the Allegheny Mountains and on the Appalachian Plateau, and in most of the subregion of the Pocono Plateau (Figure 7); the negative effects of adverse topographical and soil conditions on agricultural operations, and thus, the maintenance of a farm population engaged in agriculture was presumed to be the most fundamental cause of the high loss rates in the agricultural population. These subregions particularly lack the physical resources, such as the level and well-drained lands, climate, and soils much favored by commercial farming and the new technological changes in agriculture. As early as the beginning of this century, new agricultural techniques had the decided and increasing effect of outmoding a large portion of the sloping, wet, and less fertile lands (Baker, 1921). The costly new agricultural systems partly adopted in the above areas of the northern Appalachians were generally found unfitted to the physical resources of these areas and the traditional farming systems that had gradually evolved to meet the natural constraints of such areas could not compete commercially with the agricultural systems of those areas with much more fertile soils and milder climates.

Western Pennsylvania. Largest rates of farm population decreases which were mostly in western Pennsylvania tended to be associated with rural counties. In the last three decades only a few moderately urban counties, specifically McKean, Venango, Jefferson, Beaver, and Cambria, with urban populations of 40 to about 70 percent had continued high loss rates; However, the urban influence in the first three counties was probably less than the rural as their rural populations exceeded their urban. As to highly urbanized counties, only the county dominated by Pittsburgh, Allegheny County, was among the counties with the highest rates of farm population decreases. The strong rurality of counties with high farm population losses for the several last decades indicated the lack of adequate alternative and sufficient working opportunities outside of agriculture prompted some persons to leave farming, particularly given the technologically outmoded physical resources of western Pennsylvania.

Resource extraction areas. Some secondary economic activities, using the physical resources obtained, dominated western Pennsylvania's economy. Demand for coal, really the base of the economy in many areas, fell off precipitously after World War II. Coal's chief competitor, oil, increasingly powered locomotives, heated homes, and produced "thermal" electricity. A more efficient process for making coke used in steel manufacturing reduced the amount of required bituminous coal. Steel production declined and the new technology introduced into the industry reduced the number of steel jobs (Stevens, 1964, pp. 348-351). The railroads were heavily dependent on the resource extraction industries, especially coal, and thus suffered attrition which eventually ended in the demise of many rail routes and companies. Railroad mergers were counterproductive for the welfare of many communities as many rail lines, repair, and maintenance facilities were abandoned. Before the I.C.C., Shapp (1963) in sworn testimony with a historical perspective warned of the damage that would be inflicted on many communities and on the greatly reduced chances of industrial redevelopment if the two giants of railroading in the Northeast, the Pennsylvania Railroad and the New York Central, were allowed to join and create yet another monopoly to stifle "active competition" in the Commonwealth. The large rural populations including the farm population of Pennsylvania encountered serious unemployment, low and declining income, shrunken local markets--all made more prevalent and encompassing because of the undiversified economies.

Depressed areas. The decline of the mining industry and the advancement of mining technology displaced thousands of miners and generated a long-lasting stagnation on to the State's coal regions. As more than half of the counties of Pennsylvania mined coal, the downfall of this primary economic activity was a basic cause of much of the distress experienced by many Pennsylvania localities during the mid-Twentieth Century. In 1955 four of the nine large areas with "very substantial labor surplus" (with more than 12% of the working force unemployed) were in Pennsylvania (Stevens, 1964, pp. 348-350).

Between 1940 and 1960 the rate of income growth for Pennsylvania placed it forty-fourth among all the states. Income problems for farm people had obviously come before those of other occupational groups, for even in 1929, the Pennsylvania farmers acquired barely more than half the average annual income of that of the urban people and average annual farm income was slightly more than one-fourth that of California (Stevens, 1964, pp. 345 and 359). Nonetheless, the economic situation for farmers worsened with the Depression and the fundamental declines in the pervading economic activities of coal mining, iron and steel manufacturing, and railroading, and also the effects of the earlier forestry work slowdowns reduced the local markets and demand for agricultural products. "The extent to which agriculture overlapped with mining and manufacturing as a part of the economy of many a Pennsylvania county is noticeable" (Stevens, 1964, p. 345).

Compounding the recovery of economic health of many of the depressed areas was the widespread devastation inflicted upon the natural environment through the increased use of strip mining and the deposition of waste materials of mining in giant piles or culm banks on the surface. The despoiled natural environment was said to have been a major obstacle in the attraction of new industry to the coal areas (Stevens, 1964, p. 350). Although some recognition has been given to the negative effects of the monetary distractions of coal mining and oil and gas production on farmers' desires to farm (Miller and Parkins, 1928, pp. 114-115; Murphy, 1937, pp. 470-471) apparently little study has been done on the destruction by strip mining of the land resource base of agriculture in Pennsylvania (Miller, 1949, pp. 94-97). The direct and indirect influences of the nonagricultural but rural economic activities have undeniably had an important impact but statistically inseparable effect upon the agricultural systems, and thus also, the farm population.

Subregions of Least Farm Depopulation

Not all counties with high proportions of rural populations have had high rates of farm population losses.

Central Pennsylvania. A contiguous block of Central Pennsylvanian counties, with no coal mining and with rather high percentages of rural populations, have retained agricultural persons on the farms to a greater extent than any other areas of the northern Appalachians. These counties, e.g., Union, Snyder, Mifflin, Juniata, and Perry, located in the heart of the ridge and valley physiographic region of Pennsylvania, have had by necessity, because of the extremely steep slopes of the ridges, nearly all farm land concentrated in the valleys, enriched in places by the underlying limestone. As the modern agricultural systems have had special affinity for level and fertile lands, many farm persons were able to stay on their lands with some incorporation of the new ways of farming. As fewer farms were sited in areas with rough topography than any other part of the northern Appalachians, because of the extreme nature of the relief, farmers of the subregion have seldom given up their farms because topographical conditions did not fit the mechanization of new agricultural systems. From the end of World War II until about 1960 this part of Pennsylvania along with some of southeastern Pennsylvania had the lowest rates of agricultural land abandonment and some townships had increases in farm land (Slocum, 1969, pp. 45-46). Some of the reasons for these low rates of abandonment and actual increases in agricultural acreages in some localities can be traced to the presence of the Amish and the Mennonites, the more conservative religious subgroups of whom especially uphold farmlife as the most ideal way to live which coincidentally permits better social control of the sects' members. The Amish are conspicuously present in eastern Centre County and within the Kishacoquillis Valley of central Mifflin County; they came to the latter in 1791 from southeastern Pennsylvania (Klein et al., 1973, pp. 440-441). Both the Amish and Mennonites can be credited with the restoration of good farm land from the state of abandonment in various parts of the Commonwealth; a geographical study of this most beneficial and private development would provide very valuable basic information and lessons for rural development programs.

Urban areas. Perhaps the most important areal pattern revealed by the cartographical comparison of several decades of farm depopulation were the relatively low rates of farm population reductions in the most urban counties, except for Allegheny County. The most urbanized counties--Broome, Lackawanna, Luzerne, Erie, Blair, Northumberland, Schuylkill, and Westmoreland--have not had continually high or even moderate rates of farm population decline as have many of the rural counties located in the coal mining areas. Some of the counties however had one decade of major losses since 1940. The fact that the majority of the most urban counties have had some of the lowest rates of farm depopulation indicated the direct urban effects, i.e., those of urban encroachment upon agricultural lands, have not been among the most important reasons for persons leaving the farms and that urban forces alone have not had the magnetic qualities for farm people as so often presumed. Some study of the types of farms in these urban counties possibly would disclose a much higher percentage of estate and semi-urban farms than in other counties somewhat analogous to the wealthy farm holders in the Philadelphia suburbs and the renowned horse farms adjacent to Lexington, Kentucky, both types given credit for much of the preservation of open space in the urban environs. As Pennsylvania has had an exceptionally low population growth rate and a modest increase in the urban populace with little change in the percentage rural and urban composition in the last decades, the urban effects have undoubtedly been less than in rapidly growing regions of the United States.

Recommended study areas. A few counties although losing farm population since 1940 achieved the best records for keeping persons in agriculture and should be the study areas of future field investigations to obtain answers as to what can aid farm families to continue farming. The counties meriting an observational examination are Chautauqua, Cortland, Union, Juniata, Perry, and probably Tioga (in Pennsylvania), Centre, and Somerset, as the farm population retention rates were also high for the latter three in the 1950s and the 1960s.

An Overview of Farm Depopulation

The 1910 to 1930 Period

During 1910 to 1930, the southern third of the northern Appalachians had very little farm depopulation; whereas, to the north across a narrow transitional belt of counties, stretching nearly all the way east and west in Pennsylvania, were counties of heavy losses except for a few scattered counties primarily in New York (Figure 7). The farm population changes in this period produced areal patterns that suggested considerable spatial correlations. Some speculative thoughts as to the basic causes of these patterns follow.

The southern subarea. Southwestern Pennsylvania is a part of the Allegheny Plateau that composes much of the northern and western portions of West Virginia and as such, resembles the central Appalachians more than any other part of the northern Appalachians. This area of Pennsylvania has had significant losses recently in population as have the central Appalachians; and likewise, its economy has long been based on the vast and rich soft coal deposits. However, during 1910 to 1930 the coal industry in this subarea was still economically healthy although there were some indications of decline. World War I greatly increased the demands on the railroads; the steel and related heavy industries concentrated in this part of Pennsylvania. Such an economy generated demand for local agricultural production. Within the Allegheny Plateau of the Commonwealth small farms predominated in the more rugged southern locations and larger farms appeared in the more northern areas (Pillsbury, 1971, pp. 4-5). At this time, probably the subsistence characteristics of many of the small farms permitted easier adjustments to the rapidly fluctuating economy than did the larger farms located mostly outside of the main soft coal production areas of southwestern Pennsylvania. The larger farms with more capital invested had much more to lose from the decreasing prices of farm products.

The northern subarea. In the northern portion of the northern Appalachians, the high rates of depopulation on the farms from 1910 to 1930 may have reflected the effects of the broad acceptance of a new system of agriculture, commercial dairying. The change to dairying often required farm consolidation which displaced subsistence farm families. Some of the agricultural experiences of New England (Wilson, 1936) probably affected the northern part of the Region earlier and more intensively than the southern because this area had both physical and cultural characteristics akin to those of New England.

The 1940 to 1950 Period

In the 1940s the counties with the highest levels of farm population stability had peripheral locations in the region partially reflecting the availability of defense jobs and the presence of dairying, both of which allowed young men under certain rules to be deferred and remain on the farm (Figure 8). The farm persons of the more central parts of the Region inflicted with inadequate transportation, physical and social isolation, much agriculturally marginal land, and limited working opportunities had few alternatives except to seek work elsewhere, to find a part-time job if available, and/or to continue subsistence farming. In northeastern Pennsylvania the side effects of the decreasing demand for anthracite coal were first experienced in the counties surrounding the northern field in Lackawanna County. Many farmers of the northern Appalachians were still very much dependent on the demands of the local populations.

The 1950 to 1960 Period

The areal patterns of farm population change in the 1950s resembled somewhat those of the previous decade. A large cluster of counties with high farm depopulation rates was revealed in western Pennsylvania (Figure 9). The location of the counties with good farm population maintenance rates in southern New York, most of northeastern Pennsylvania, and central Pennsylvania connoted an association with the importance of dairying; whereas, in most of western Pennsylvania where widespread depopulation of the farms prevailed, dairying was of much less significance and general and mixed farming dominated. The less commercialized nature of agriculture in much of western Pennsylvania, partly because of the less availability of favorable physical resources, motivated many farm people to seek part-time off the farm employment that eventually led many out of farming. The continued decline of anthracite coal mining in the northern and central fields may have adversely affected the farm population of Luzerne, and Carbon counties.

The 1960 to 1970 Period

In the 1960s less variation in the farm population change rates characterized the Region than in the 1950s; thus, the possible meanings of the county areal patterns of farm depopulation were less evident (Figure 10). Farm depopulation was more general in geographical occurrence, but there were a few contiguous counties with similar conditions and rates of farm population losses. The counties with the best records of holding farm families on the agricultural land in this decade tended also to have held on to their farm populations better than most counties in the other decades since 1940. These counties' characteristics favorable to agriculture were discussed earlier. Several blocks of counties known for particular economic pursuits had relatively high farm population losses, prompting queries as to the effects of these operations on the conduct and nature of agriculture.

The oil and coal areas of western Pennsylvania. The counties known for their oil production--McKean, Venango, Warren, Elk, Forest and to a lesser degree a few adjacent counties had proportionally high farm population declines. The area immediately south of these major oil counties, in west-central Pennsylvania, and particularly in Clearfield, Jefferson, Butler, Clarion and Armstrong, had only somewhat lower loss rates and were the counties of major coal-strip mining operations. Both the extraction of oil and coal have led numerous times to local "boom and bust" economies, leaving behind ghost towns and abandoned farms.

The anthracite mining areas of eastern Pennsylvania. The additional areas of high relative decreases in farm persons were in extreme eastern Pennsylvania and the eastern fringe of New York. From 1940 to 1970 high farm depopulation rates occurred in the hard coal counties, first in the northern ones, then the central, and lastly the southern. The southern hard coal counties with heavy loss rates of farm persons in the 1960s decade were Carbon, Northumberland, and Schuylkill. The differential areal and temporal declines in anthracite production apparently effected the farm population loss rates accordingly.

The recreational areas. Lastly, the counties in the recreational areas of the Pocono and Catskill highlands had relatively large reductions in numbers of persons living on farms, partly caused by residents of megalopolis who purchased a second home and some land in an altitude presenting cool temperatures where they could escape from the oppressive heat and air pollution of the big cities in the summer. The establishment of "residential farms" changed the preexisting types of farming, e.g., by increasing the renting of land, and brought changes to agricultural systems in the Region.

Methodology

Relationship of the Problem to the Method of Analysis

In research, about the first task is to choose a topic and/or problem. The outcome of this first step in research depends upon the researcher's experiences, interests, and education; all of these played an important part in the selection of the farm depopulation problem for this dissertation, but perhaps, the first influence was basically the most persuasive. The author knew through years of living and working on farms in Susquehanna County, from seven years of studying and residing in Monroe and Centre counties, and from traveling in northeastern, central, and west-central Pennsylvania and southeastern New York that the degradation of agriculture and the depopulation of the farms constituted two general and serious problems in most rural communities of the northern Appalachians. Thus, there arose the question: how much are the two phenomena related?

The loss and deterioration of farms and the agricultural and human resources really constitutes one problem in numerous localities but is nevertheless a multifaceted problem. Earlier the author studied one major aspect of the total problem: the abandonment of Pennsylvania agricultural land in the post World War II period (Slocum, 1969). The retrenchment of agriculture and the general agricultural changes in the northern Appalachians, have had numerous negative effects, including changes in land use; but, the consequences for farm persons have received generally insufficient attention in public sponsored research. An agricultural administrator of the United States' Economic Research Service in mid-1973 said,

> Much of our past research has been based on an objective of efficiency in the land-labor-capital context. This has little relevancy to this group of small farmers and rural residents (West, 1973, p. 2).

The farm resident deserves much more emphasis than that provided by the view that he is just a resource or input similar to the other resources necessary for agricultural production because he, in himself, combines many resources, including management abilities, in addition to the fact that he is a human, a quality around which many of our values coalesce. Thus, to think of the farm person only in respect to his potential contribution to agriculture, without regard to other aspects of his life and the effects which agricultural changes may have on his welfare is an approach of analysis that produces results of limited applicability to his welfare. To avoid the treatment of persons engaged in agricultural pursuits only as agricultural production variables, it is desirable to regard them as constituting a separate system, i.e., a farm population system interacting with either an agricultural system or subsystems; then, the effects of one upon the other may be seen from a wider perspective.

A Systems Perspective

A broad perspective is often preferable in research because of the frequency of problems having multiple causation. Causes are often composed of sub-causes originating from various systems. Solutions with effective results have been achieved infrequently in the past because of an overly-specialized approach to a problem--the analysis of the workings of only one system or a subsystem. The repercussions often only appear in observational form in the long run, and thus go unrecognized, increasing the intensity of problems. For example, the errors of not regarding the effects of man-made systems on natural systems finally became obvious as environmental problems became serious. The human system is as fully complex as the natural; we cannot pretend to know of all the influences and their consequences upon the human being, but we need to know as a minimum, that systems often interact with each other and elements of one system interact in varying degrees with those of other systems.

An example of a number of interacting systems pertinent to the general theme and approach of this study could be given as follows. The acceptance of at least some parts of agricultural systems, e.g., tractors with auxiliary power machinery, generally made life easier for farm families. In the northern Appalachians, however, much of the land was unsuited to the new agricultural technology. Consequently, the potential production and competitive position of many farms frequently became less, lowering many a family's economic standing and affecting the local economic system. Yet, many agricultural innovations, like the automobile, were considered essentials of modern living and of the new social systems.

Another example of the interrelationships among systems relevant to the study area supplies support to the use of the systems approach. The farmers held a high proportion of land which gave only minimal returns. Agricultural changes caused more land to be unsuitable for modern farming. Nevertheless, taxes had to be paid on this outmoded land by farmers and as the costs of upgraded school systems and of other public services expanded, the farmer paid higher taxes on more lands that could no longer produce given the new agricultural technology. The major cost that many individuals had to pay for the privilege of living in the countryside and/or on a farm was the acceptance of a lower standard of living, a consequence produced by the interaction of several systems.

The System Concept

Thus, the general approach chosen for this research is most closely related to systems analysis, more in a conceptual way than an operational or applied sense. The meaning or concept of "system" is a mental construct and gives orientation to this study. The idea of systems is attractive to researchers because of the large fundamental accumulation of knowledge about the major classes of systems, i.e., open and closed, and on the similarities in structure, behavior, and states.

"A system may be simply defined as a whole composed of parts which interact. The parts are called elements of the system" (Carey, 1970, p. 179). The element is the basic unit, but at certain resolution levels of analysis it may be regarded as a system. Two broad classes of systems are the closed and open systems. The open system is the most representative of the real world and unlike the closed system will permit matter to pass its boundary as well as energy (Carey, 1970, p. 180). Through time (history) Boulding (1970) sees systems operating in one of four ways: randomly, mechanically, teleologically, or ecologically (selectively). Although there exists a large collection of literature on systems analysis, the discussion is restricted primarily to works in geography to correspond to the perspective of the discipline in which this study is done.

Systems theory in geography. Harvey (1969), among the geographers, perhaps best analyzed the concept and "subconcepts" of systems analysis and concluded ". . . that methodologically the concept of system is absolutely vital to the development of a satisfactory explanation" (Harvey, 1969, p. 479). Ackerman (1958) in his review and assessment of geography as a basic research discipline and in his emphasis on process was among the first geographers to advocate the use of systems thinking in geographical research. James (1972) wrote,

> each kind of process is also modified by the presence of other things and events of unlike origin that exist together in mutual interaction in earth space. The interconnections among things and events of unlike origin on the earth form systems of functionally related parts (James, 1972, p. 459).

A system that contains at least one important spatial variable, e.g., location, distance, direction, extent, density, and succession is considered a spatial system (Wilbanks and Symanski, 1968). Writings on systems related to geography have become common in the last fifteen years (Chorley, 1962; Foote and Greer-Wootten, 1968; Langton, 1972; McDaniel and Hurst, 1968; Walmsley, 1972).

Agricultural Systems

Much has been written on agricultural systems, but there exists no real universal agreement on the meaning of the concept. The International Geographical Union for several years has had a subcommittee addressing the problem under the direction of Kostrowicki who has written extensively on the topic. Some notable research on agricultural systems has been carried out in the past (Grigg, 1974; Duckham and Masefield; Harris, 1969; Helburn, 1957; Olmstead, 1970; Spencer and Stewart, 1973).

The General Model

Consideration of all the systems influencing and interacting with the farm population would present a study beyond the necessary scope of this work. The point of reference thus selected for this study is that changes in agricultural systems due to the forces (the mechanisms) from the ever-enlarging and encompassing technological system or environment are basic to an explanation of the overall state of the farm population system at any given time. The ultimate effects of these change forces on the interrelationships of agricultural and population systems and the subsequent displacement of farm population within an area varies however according to the site and situational characteristics of a place and an area (Figure 11). The technological derived forces shaped by these geographical factors result in differing removal rates of persons off the farms. The primary resources of agriculture were envisioned in bundle-like groups, termed components of agriculture, e.g., land, capital, labor, mechanization, and off the farm inputs. The changing nature of agriculture was thought to be a reflection of the increasing inputs on to the farms from the technological system and environment.

General Procedure of the Analysis

Once the dependent variable was selected to represent the problem, several decisions had to be made on what variables would represent the tentative explanations and would be tested. The chosen variables (Appendix A) generally fitted the subsystem categories of an agricultural system as shown in Figure 11. These variables as attributes of the subsystems or elements of the agricultural systems were hypothesized as having been likely influenced by the spread of technology to the farms. Some of the variables, e.g., tractors,

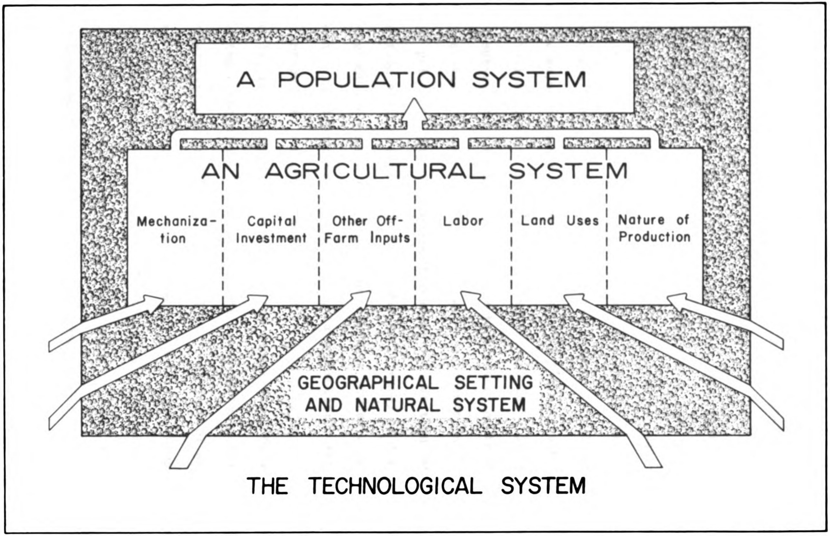

Fig. 11.--Basic Model of Technological Interaction with a Population System through Natural and Agricultural Systems.

fertilizer, and feed, reflected particularly direct influence of outside technology on the farm.

The variables relationships to farm depopulation were first tested with the use of multiple correlation. Secondly, because the variables were not independent of each other, principal components analysis provided a way to gain this independence that is assumed by correlation and regression analysis. The correlation matrices for each of the time periods served as the input for the principal component analyses. In addition, principal component analysis served as the major means of obtaining a summary of the agricultural data. Principal components of importance resulted for each time period and were subsequently interpreted by the author according to the loadings (correlation) that each variable had with each component. Each major principal component for each time period was then mapped and a depiction of the basic nature and areal differences of agriculture throughout the Region resulted. The component scores were lastly ran with the dependent variable, i.e., farm population retention percentages, in a stepwise multiple regression program (Wittick, 1971). Finally, the residuals obtained from the regression program for selected components were mapped and the areal patterns analyzed for further explanation of farm depopulation. This form of analytical procedure and method was first applied prior to 1969 (Romsa, Hoffman, Gladin, and Brunn, 1969). Several sources gave the basic information necessary to carrying out the analysis (Berry and Marble, 1968; Bryn Greer-Wootten, 1972; King, 1969; Robson, 1969; Szabo, 1971; Thomas, 1968).

CHAPTER 4

ANALYSIS OF STABILITY AND CHANGE OF AGRICULTURAL VARIABLES AND ATTRIBUTES IN THE NORTHERN APPALACHIANS, 1910-1970

Important Temporal Associations of Agricultural Attributes

A comparison of the correlation coefficients matrices for the four time periods reveals some of the variables chosen as criteria and measures of agricultural systems (Appendix A) are significantly interrelated for two or more time periods (Table 7). Significance is defined as either an r of +.60 and more or -.60 and less. The variables that mutually maintain an important interrelationship through several decades are thought to be the most stabilized attributes of the agricultural systems.

The Traditional Attributes and Their Associations

It seems reasonable to expect if the same types of farming continued over time in an area, similar relationships between some attributes would be maintained while others changed. These associations which remain through several time periods indicate essentially that the same systems of agriculture have prevailed in the region for a number of decades. The traditional associations of agricultural

Table 7.--Agricultural Variables Interrelated for Two or More Time Periods; the Traditional and Change Attributes of Agricultural Systems.

Variable* ID Number	Variable Names	Time Period 1909-1910	1929-1930	1949-1950	1969-1970
		Correlation Coefficients (r)			
4 8	Avg. $ spent for gas Avg. expenditures for fertilizer			.68	.79
4 12	Avg. $ spent for gas Avg. cropland acreage			.78	.81
4 13	Avg. $ spent for gas % cropland harvested			.60	.63
5 6	Avg. value of land and buildings Avg. value of implements and machinery	.63		.63	.66
5 9	Avg. value of land and buildings Farm persons per 100 acres	(.58)	.65	.68	.61
5 10	Avg. value of land and buildings Value of hired labor	(.52)	.66	.61	
6 18	Avg. value of implements and machinery Land productivity	(.55)	(.54)	.72	.62
7 16	Avg. expenditures for feed % of total farms, dairy			.62	.61
7 19	Avg. expenditures for feed Labor productivity	.73		.92	(.56)
9 11	Farm persons per 100 acres Avg. size farm in acres	-.92	-.90	-.92	-.60
10 18	Value of hired labor Land productivity		.68	(.58)	.67
11 16	Avg. size farm in acres % of total farms, dairy		(.55)	.71	.71

Table 7.--Continued.

Variable* ID Number	Variable Names	Time Period 1909-1910	1929-1930	1949-1950	1969-1970
		Correlation Coefficients (r)			
14	% harvested cropland, hay		.85	.90	.77
15	Pasture-cropland ratio				
16	% of total farms, dairy		.82	.73	
19	Labor productivity				
21	% farm operators working 100 days off the farm			-.60	-.64
4	Avg. $ spent for gas				
21	% farm operators working 100 days off the farm			-.69	-.62
7	Avg. expenditures for feed				
21	% farm operators working 100 days off the farm			-.74	-.76
16	% of total farms, dairy				

Source: Matrices of Correlation Coefficients, Appendices C to F.

*The numbers for 1909-1910 have been changed to correspond to the designated numbers for each variable of the other time periods.

characteristics preserved for the longest times during 1910 to 1970 will be first analyzed.

Values of land/buildings and implements/machinery. Since 1910, except for the Depression period when land values reached a low level, a moderate and positive relationship has existed between the average value of land and buildings per farm acre and the average value of implements and machinery per farm acre. Farms with large land and building investments have generally had large investments in implements and machinery; and conversely, those farms with low investments in one also had a low capitalization in the other. Therefore, less trading off in the concentration of capital in one to possibly increase production seems to have occurred than might have been expected. The production benefits of trade-offs among these investments may be much less than generally assumed. Dairy farmers, for example, need to have reasonably good buildings to maintain the health of their cows and calves, but at the same time require reliable machinery to harvest within the optimum time and between periods of adverse weather the quality crops and forage necessary to obtain and maintain maximum milk production and healthy herd replacements. Crop farmers need quantity and quality in equipment to plant various crops and also to harvest during short seasons; but in addition, the highest yields are to be gathered from the most fertile lands which are often the highest priced. Adequate storage facilities must also be owned to keep the crops from spoiling. Consequently, high investment in one factor of production often necessitates at least adequate investment in another for profitable returns (Heady and Tweeten, 1963).

Value of land/buildings and density of farm persons. From about 1910, the average value of land and buildings has been also moderately and positively related to the number of farm persons per 100 acres. The more persons present on a given acreage the higher the value of the real estate. More persons may supply the additional labor for proper maintenance of the buildings, e.g., roofing, painting, repairing, and the construction of additional buildings. In a like manner, additional hands could contribute to the "improvement" and development of arable land, the greater amount of which would increase the value of the farm; this relationship is also suggested by the positive association of the average value of land and buildings with the value of hired labor, especially through the 1930s and the 1940s when farm labor was more available and at more affordable wage rates.

Farm people have had traditionally larger families than other population groups and the above relationship indicates that the economic motive for having more children, and thus more labor on the farm, is rational and results in extra capital which may be invested in additional or more valuable lands and buildings. Also, some farm couples may choose to have more children if they possess initially more than adequate assets, including housing and land.

Farm persons and average size farm in acres. Over the decades of this study, except for the most recent time, the relationship of the number of farm persons per 100 acres to the average size farm in acres has had the highest r value (-.92) and has proven to be the most traditional characteristic of farming in general. The relationship is in one sense, however, easy to interpret, rather obvious, and perhaps not very meaningful. One would expect areas where farms are larger to have a lower ratio of farm persons per acreage and areas where farms are smaller to have a larger farm population density. Some of the higher associations in the earlier years of the study period could be explained by the greater presence of small self-sufficing farms with large families, the existence of which are partly attributable to limited contact with the modernization process, socioeconomic changes, and urban society. The major decline in the value of -.92 in 1910 and 1930 to an r of -.60 in 1970 reveals seemingly the effects of some recent major structural changes in agriculture and the farm population in the northern Appalachians.

Percent harvested cropland, hay and pasture-cropland ratio. A relationship remaining important over many decades is the positive association of the proportion of the cropland which is hay with the pasture-cropland ratio. There are large areas of the northern Appalachians which have relatively much of their cropland in "permanent hay" and this has been especially true in the dairying areas where there exists a large amount of pastureland relative to cropland. With the advent of the more intensive use of cropland, the percent of cropland in hay recently has been declining. Because of more farm costs, additional mechanization, increasing use of the "new" technology, and an emphasis on grain cultivation, less cropland could be left in hay. Many of the farms with high relative amounts of permanent pasture have ceased to be used for farming due to an increasing trend of planting fodder crops on the cropland. Extensive farming, i.e., the use of large amounts of land with a low rate of return per acre, is becoming less characteristic of the Region's farming than in the past, but still remains an important general characteristic.

Temporal Patterns of the Important Agricultural Change Variables and Their Associations

The distinct temporal differences in the kind of variables composing the important interrelationships within the agricultural systems of the northern Appalachians of the Twentieth Century are very evident and engrossing (Table 7). The changes in the variables producing the most important correlations give clues to the changes in the operations and the resource inputs of agriculture. Nearly the same important agricultural characteristics of the time around 1950 were of significance in 1970. The agricultural conditions around 1910 and 1930 appear though quite different; however, the dissimilarities between these two times may not be as large as the figures indicate because data could not always be obtained or was not appropriate for all the selected agricultural criteria in 1910. The 1930 data contains relationships that document some of the beginnings of the agricultural tendencies that were to characterize agriculture in the Region in the 1950s and the 1960s. However, the scarcity of r's in the 1910 column of Table 7 does not necessarily indicate completely new agricultural systems have developed in the northern Appalachians within the last three to four decades. Some farming systems predate World War I, e.g., dairying, and considerable evolution in the elements composing each has resulted in the changing appearance of agriculture.

The ranking of the important correlations of the agricultural variables from moderate to high importance by year reveals some valuable insights into the changing nature of farming in the Region through the last half century.

Basic agricultural characteristics in 1909-1910. In 1909-10 data, the variables forming the highest positive correlations were: labor productivity, land productivity, and expenditures for feed (Table 8). Therefore, two on the farm resources, labor and land, greatly affected the productivity of the farms. The average values of implements and machinery were moderately related to several agricultural attributes; thus, mechanization was beginning to play a part in some agricultural systems. Yet, the primary influences of land, family labor, and hired labor remained dominant in production activities.

Basic agricultural characteristics in 1929-1930. Between 1910 and 1930 land and labor became less able to characterize farming, although labor continued moderately related to several variables. The expenditure for feed association with the expenditure for fertilizer at $r = .97$ was the highest intercorrelation among the agricultural attributes during 1929-30. Three of the farm inputs: average expenditures for feed, average expenditures for fertilizer, and average value of implements and machinery were very highly associated (Table 9). Some elaboration upon these close relationships among three nonfarm inputs is necessary to illustrate how agriculture had changed during the first decades of the Twentieth Century in the northern Appalachians and to give insight into their probable effects on the farm population.

Table 8.--Highest Linear Correlations Among Agricultural Variables, 1909-1910.

Variable ID Number	Variable Name	r
5:7	Farm persons per 100 acres Avg. size farm in acres	-.92
11:12	Land productivity: Agr. sales per acre Labor productivity: Agr. sales per agr. person	.74
3:12	Avg. expenditures for feed per farm reporting Labor productivity: Agr. sales per agr. person	.73
3:6	Avg. expenditures for feed per farm reporting Value of hired labor per farm reporting	.69
2:5	Avg. value of implements and machinery per farm acre Farm persons per 100 acres	.67
2:7	Avg. value of implements and machinery per farm acre Avg. size farm in acres	-.66
2:4	Avg. value of implements and machinery per farm acre Avg. expenditures for fertilizer per farm reporting	.65
3:9	Avg. expenditures for feed per farm reporting % harvested cropland which is hay	.65
6:13	Value of hired labor per farm reporting Ratio farm expenses to value of agr. products	.65
1:2	Avg. value of land and buildings per farm acre Avg. value of implements and machinery per farm acre	.63

Source: Matrix of Correlation Coefficients, Appendix C.

Table 9.--Highest Linear Correlations Among Agricultural Variables, 1929-1930.

Variable ID Number	Variable Name	r
7:8	Avg. expenditures for feed per farm reporting Avg. expenditures for fertilizer per farm reporting	.97
6:8	Avg. value of implements and machinery per farm acre Avg. expenditures for fertilizer per farm reporting	.92
9:11	Farm persons per 100 acres Avg. size farm in acres	-.90
6:7	Avg. value of implements and machinery per farm acre Avg. expenditures for feed per farm reporting	.88
14:15	% harvested cropland, hay Pasture-cropland ratio	.85
16:19	% of total farms that are dairy Labor productivity: Agr. sales per agr. person	.82
4:10	Avg. $ spent for gas per farm Value of hired labor per farm reporting	.73
10:20	Value of hired labor per farm reporting Ratio farm expenditures to value of agr. production	.73
3:18	% farms reporting trucks Land productivity: Agr. sales per acre	.70

Source: Matrix of Correlation Coefficients, Appendix D.

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As feed grains represented one of the first major purchased resources, this outside input probably led to greater outside dependence on the other off the farm resources. As earlier stated, there was a significant degree of statistical interrelatedness among these outside inputs; i.e., the use of one tends to lead to the use of another or others. Did the increased use of feed grains create a need for fertilizer? In the decade of 1910-20 some dairy farmers in Delaware county, New York bought 98 percent of their needed feed grains. The general high use of bought feed motivated farmers to produce protein and minerals in the form of leguminous hays (Fippin, 1921, pp. 204-205) which required the use of more fertilizer. Yet the total rationale for the high positive relationship between these two variables is difficult to determine, particularly when in 1909-1910 and 1949-1950 the associations were very minor. The following may provide additional understanding of the correlation between feed and fertilizer in 1929-30.

During the 1920s the "surplus production problem" in American agriculture first took on national dimensions, following the greatly increased capacity to produce which developed during World War I. Contrary to general expectations, farmers did not cut back production to meet the much lowered international demand (Benedict, 1953, pp. 233-234). Farmers pushed production even further in an attempt to raise their declining gross incomes as farm prices dropped (Hampe, 1964, p. 80). As some feed grains were surplus commodities at relatively low prices, they represented a rational procurement of a resource whose use would result in a rather rapid increase in production and in a higher income, e.g., more pounds of milk and a larger milk check.

Because of the necessity to increase production on the farm to stay in business, especially in a time of decreasing gross incomes, a general tendency existed for farmers who began to use one major off the farm input to be also the ones who used other new "outside" inputs, e.g., fertilizer. The person who accepts one innovation is likely to accept another (Rogers, 1962, pp. 186-187). The very high intercorrelations among three variables: average expenditure for feed, average expenditure for fertilizer, and average value of implements and machinery appear to mean that where one of the "new inputs" was accepted, the other two were generally adopted, also. As there was a continuous movement of farm persons out of agriculture during the 1920s, the use of these inputs from off the farm was an attempt to compensate for less labor and to raise the productivity of labor that remained. The abatement of the relative role of labor in agriculture was on going; thus, labor was not a component of the largest correlations among the agricultural attributes in 1929-30.

Basic agricultural characteristics in 1949-50. By 1949-50 the expenditure for feed had become highly correlated with labor productivity and a significant characteristic of the Region's agriculture (Table 10). The Region's farmers had perfected the efficient use of feed grains to increase the worth of their labor. The high positive relationship of feed expenditure to labor productivity implies a very heavy and continued dependence upon an off the farm input--as only a small amount of the desired feed grains were grown within the

Table 10.--Highest Linear Correlations Among Agricultural Variables, 1949-1950.

Variable ID Number	Variable Name	r
7:19	Avg. expenditures for feed per farm reporting Labor productivity: Agr. sales per agr. person	.92
9:11	Farm persons per 100 acres Avg. size farm in acres	-.92
14:15	% harvested cropland, hay Pasture-cropland ratio	.90
4:12	Avg. $ spent for gas per farm Avg. cropland acreage per farm reporting	.78
21:19	% farm operators working 100 days off the farm Labor productivity: Agr. sales per agr. person	-.76
21:16	% farm operators working 100 days off the farm % of total farms that are dairy	-.74
16:19	% of total farms that are dairy Labor productivity: Agr. sales per agr. person	.73
6:18	Avg. value of implements and machinery/farm acre Land productivity: Agr. sales per acre	.72
11:16	Avg. size farm in acres % of total farms that are dairy	.71
5:11	Avg. value of land and buildings per farm acre Avg. size farm in acres	-.70

Source: Matrix of Correlation Coefficients, Appendix E.

Region--to support the growth of commercial farming and to maintain economically viable farms. This association was to be expected as feed grains and meals were even supplied in the chronically short Northeast in World War I by increasing imports from Canada and South America (Wilcox, 1947, pp. 161-162). The liberal use of feed in livestock farming and dairying apparently gave increased production and sufficient returns, providing adequate incentives for a lasting reliance upon purchased feeds. Nationally, the increase in the percent of purchased feeds used per unit of U.S. farm output based upon the 1935-39 period led the relative increases of any of the selected resources until 1947 when fertilizer gained first position (Figure 12) (Smith and Christian, 1961, p. 131). Use of fertilizer in the Region, however, was relatively minor (Figure 13). The northern Appalachians mix of purchased resources differed from the Nation's.

An agricultural attribute appearing for the first time, i.e., exhibiting high correlation with one variable, was average dollars spent for gasoline. An increase in the dollars expended for gas tended to be associated with the expansion of cropland per farm. During the late 40s and the early 50s, horse numbers were rapidly declining and the substitution of horses for tractors (Figure 14) made possible the cultivation of more acres of cropland per farm as tractors were indefatigable and capable of faster rates of movement, allowing for example, more plowing, preparing, planting, cultivating, and harvesting of crops within the critical time periods.

Other major features of agriculture in the Region around 1950, were the following associations: (1) the percent of farm operators

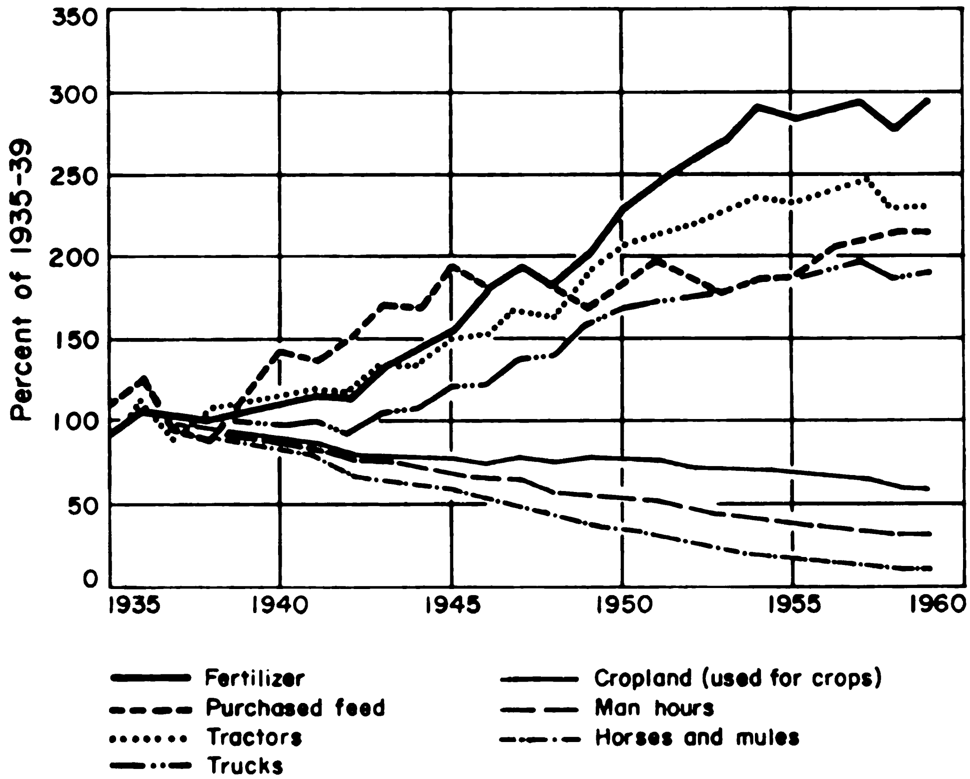

Fig. 12.--National Trends in the Comparative Use of Agricultural Resources.

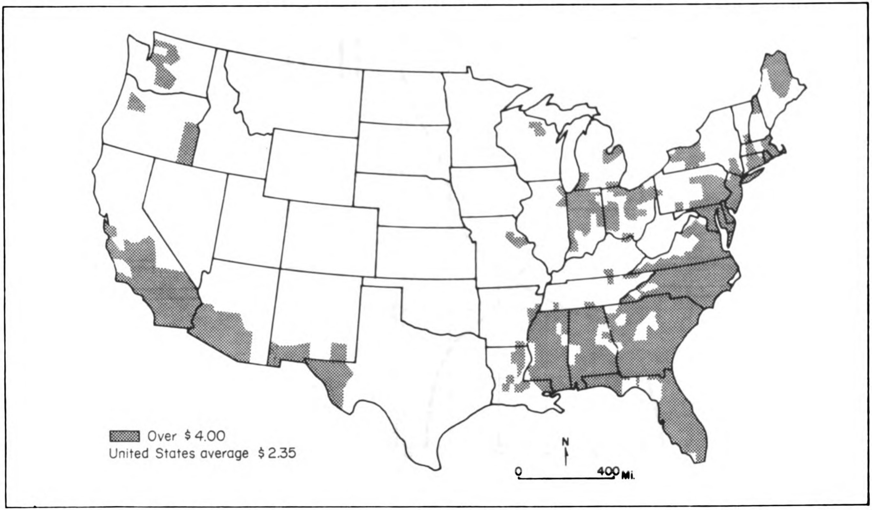

Fig. 13.--Expenditures for Commercial Fertilizer per Acre of Total Cropland, 1954.

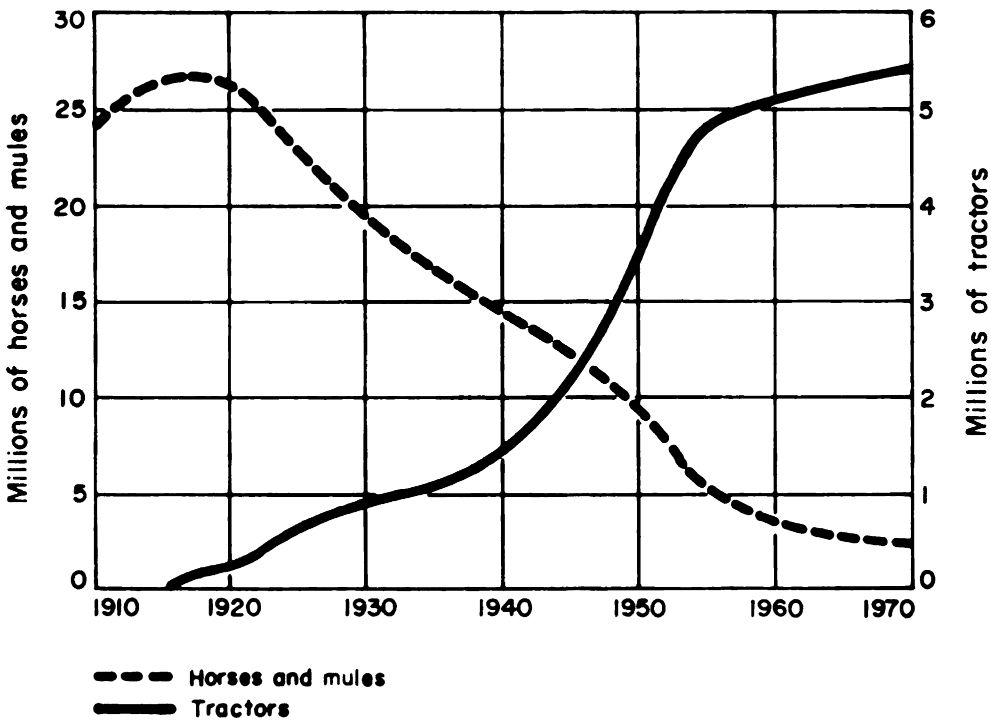

Fig. 14.--Replacement of Horses with Tractors.

working 100 days off the farm; (2) the percent of total farms, dairy; and (3) labor productivity or agricultural sales per agricultural person. The part-time farmer was defined as working at least 100 days per year in off-farm employment (Rogers and Burdge, 1972, p. 138). The numbers of part-time farms expanded from 15 percent of all U.S. farms in 1929 to 31 percent in 1949; thus, nationally these types of farms represented nearly one-third of the total farms in the post World War II period and their relative numbers continued to increase in the 1950s. During this period rural sociological research found that this kind of farming did not represent a means into or out of agriculture for most persons engaged in it, but surprisingly a "permanent status" (Rogers, 1960, p. 5).

The negative correlation, $r = -.74$ between the measure of part-time farming and the proportion of farms that were dairy revealed that in 1949-1950 the two kinds of farming were for the most part mutually exclusive. Because of the yearlong demands on the dairy farmer's time and the necessity of his maintenance of a two or three times-a-day milking schedule, the dairyman is very much restricted to farming a seven day work week--and there is little time or energy remaining for significant off the farm work. Dairymen hesitate to hire labor to care for valuable milkers each of which demands special individual attention and careful feeding so to remain a maximizing producer and a good investment. By using their own and family labor, dairy farmers experienced increases in their labor productivity. In the study area counties with a high percent of dairy farms had high levels of agricultural labor productivity. Unlike in dairying, a part-time farming enterprise can only have a part of the operator's time; thus, when the farmer works elsewhere, his farm labor productivity declines according to the extent of time he spends off the farm.

The average value of implements and machinery per farm acre as a measure of farm mechanization had increased to the point in the late 1940s and early 1950s that it had a large positive effect on increasing production per unit of land. By 1950 the northern Appalachians had achieved an $r = .72$. Mechanization permitted farming operations to begin and end on time. Machines gave the farmer more time for management, planning, and additional productive work. The increased productivity of the land made possible by the expanded mechanization rates, which has been called "the most important change in farm technology of the Twentieth Century," also had an important indirect influence on releasing the forage and grains consumed by the displaced horses to the production of marketable agricultural products (Wilcox, 1947, pp. 289-290). The major contribution of machinery came particularly with tractors, after World War II in the late 40s and early 50s in the northern Appalachians when thousands of horses were replaced by tractors. Horse-drawn equipment eventually was traded in on tractor-drawn or powered auxiliary machines.

Basic agricultural characteristics in 1969-1970. What were the major differences in the basic appearance of the Region's agriculture in the late 1960s and the early 1970s from that of the previous time (Table 11)? The disbursements for gasoline became the variable with the highest intercorrelations with other farm attributes. The intercorrelation of the average dollars spent for gas per farm with

Table 11.--Highest Linear Correlations Among Agricultural Variables, 1969-1970.

Variable ID Number	Variable Name	r
4:12	Avg. $ spent for gas per farm Avg. cropland acreage per farm reporting	.81
4:8	Avg. $ spent for gas per farm Avg. expenditures for fertilizer per farm reporting	.79
14:15	% harvested cropland, hay Pasture-cropland ratio	.77
21:16	% farm operators working 100 days off the farm % of total farms that are dairy	-.76
6:9	Avg. value of implements and machinery per farm acre Farm persons per 100 acres	.74
6:11	Avg. value of implements and machinery per farm acre Avg. size farm in acres	-.71
11:16	Avg. size farm in acres % of total farms that are dairy	.71

Source: Matrix of Correlation Coefficients, Appendix F.

the average cropland per farm rose from r = .78 to r = .81, the highest association among the agricultural variables in 1969-70. In contemporary times there is thus within the study area a relatively high positive relationship between how much cropland a farm possesses and the quantity of gasoline needed.

The second highest association also involves gasoline expenditures, related to the average expenditures for fertilizer per farm reporting with an r = .79. As fertilizer is used relatively more on the cropland today than in the past, i.e., r = .55 in 1949-50 and r = .66 in 1969-70 and gasoline expenses are closely related to the amount of cropland per farm, the emphasis on the intensity of cropland use partly explains the important interrelationship between the two purchased inputs, of gasoline and fertilizer. Once again the use of an off the farm input seemingly establishes a need for the use of additionally purchased inputs. An increase in use of fertilizer, as long as the point of diminishing returns is not reached, increases production to the point that fixed costs become accordingly decreased per unit produced and large amounts of fuel costs can be more easily rationalized. Tillage of larger cropland acreages absolutely requires greater gasoline use, and to raise the probability that this major expense will be covered, the use of fertilizer significantly increases the probability of a money-making crop.

In 1969-70 the negative association, r = -.76, between part-time farmers and dairy farms remains as important as in 1949-50. Many of the counties with low rates of farm operators working off the farm 100 days or more are counties with a high proportion of dairy farms.

The association, r = .71, between the proportion of the total farms that are dairy and average size of farms is exactly the same as in 1949-50. As the average size of farms increases the proportion of farms that are dairy rises.

CHAPTER 5

ANALYSIS OF THE COMPONENTS OF AGRICULTURE: SOME DOMINANT CHARACTERISTICS AND SYSTEMS OF FARMING IN THE NORTHERN APPALACHIANS, 1909-10 and 1929-30

Identification of the Region's Agricultural Components

The most important characteristics of the northern Appalachian agriculture were thought to be different from one time period to another, and this hypothesis was substantiated for the most part after the above analysis of the major agricultural variable intercorrelations in each era. However, there was little attempt to relate these attributes to subareas in order to identify the geographical extent of agricultural systems or types of farming. Previously, it was hypothesized some of the areal variation in farm population changes could be attributable to certain types of farming, and changes that occurred within these. As data for the relative number of farms of each type, except for dairy, were not included in the selected data some indication of the dominance of certain agricultural systems in each county is necessary to the eventual formation of theoretical statements explaining the farm population losses. Thus, a major objective of this part of the study is to associate the essence of the agricultural data with a geographical unit which in this research is the county.

It is preferable to establish the geographical patterns of the most important historical components of agriculture found in the data analysis of this study. If some of the agricultural population losses correspond with one particular component found in all farming systems, e.g., investment, than a greater study of this economic characteristic of agriculture would be warranted first to discover exactly how the component results in a decrease in the farm population and thus effects the human resources.

Using the intercorrelation matrices of the data, principal component analyses were carried out for the several decades since 1910. This type of analysis gives the correlations of the variables with the components. The components are the new independent variables and the main underlying dimensions of the data. Through observing the general nature of the listing of variables that correlate highly with each component (the correlations are called the loadings), it is possible to identify the components. Of special significance to a geographical approach are the component scores of a principal component's analysis which relate the composite variable formed from the intercorrelations of the original data matrix to each geographical unit or observation. In this study, therefore, each county has a value for each of the components chosen by the principal component's program. When these new composite values, i.e., component scores, are mapped a double-check on the interpretation of the components deduced from an analysis of the loadings is made possible by whether the tentatively identified component could logically have the geographical distribution that is revealed by its mapped component scores.

The Components of Agricultural Systems in 1909-1910

The components selected by the principal axis analysis accounted for nearly 87 percent of the total variation in the agricultural data.

The principal component in 1909-1910. The major component extracted explained more than 30 percent of the variance and correlated primarily with implements, machinery, land, and building values (Table 12). Generally speaking the spatial pattern of the high positive principal component scores, representing collectively the associated variables, support an intensive agricultural interpretation (Figure 15). The counties of Erie, Lackawanna, Luzerne, Allegheny, Cambria, Schuylkill, and Westmoreland had high land prices because of the urban use demands near such cities as Erie, Scranton, Wilkes-Barre, Pittsburgh, Johnstown, and the other industrial and coal oriented cities. Also, mechanization probably began near the cities. Additional positive values occurred in counties on the eastern and southern portions of the Region, an area adjacent to the progressive Pennsylvania Dutch agricultural domain of southeastern Pennsylvania. The lowest negative values, meaning low relative investment, tended to be those counties both isolated and the poorest in agricultural development, e.g., Fulton, Bedford, Huntingdon, Potter, Perry Sullivan, Pike, Juniata, Cameron, Forest, and Green. Most of these counties are among Pennsylvania's most mountainous. Thus, quite unexpectedly, capital

Table 12.--Major Loadings from the Principal Components Analysis of Agriculture, 1909-1910.

Positive Loadings		Negative Loadings	
Variable	Loading	Variable	Loading
Component One: Intensive Agriculture			
Value of hired labor	.80		
Avg. value of implements and machinery	.79		
Land productivity	.72		
Avg. value of land and buildings	.72		
Avg. expenditure for feed	.63		
Avg. expenditure for fertilizer	.58		
Explained Variance	30.06%		
Component Two: Cattle and/or Dairy Farming			
Labor productivity	.81	Farm persons/100 acres	-.76
% harvested cropland, hay	.76		
Avg. size farm in acres	.66		
Avg. expenditure for feed	.66		
Corn yields	.53		
Explained Variance	28.06%		
Component Three: Cropland Availability			
Avg. cropland harvested	.81	Ratio farm expenses to value of agri. products	-.83
Land productivity	.48		
Explained Variance	16.60%		
Component Four: Diversified Farming and Specialized Crops and Livestock			
Avg. expenditure for fertilizer	.53	Corn yields	-.65
Cropland harvested	.52		
Explained Variance	12.10%		

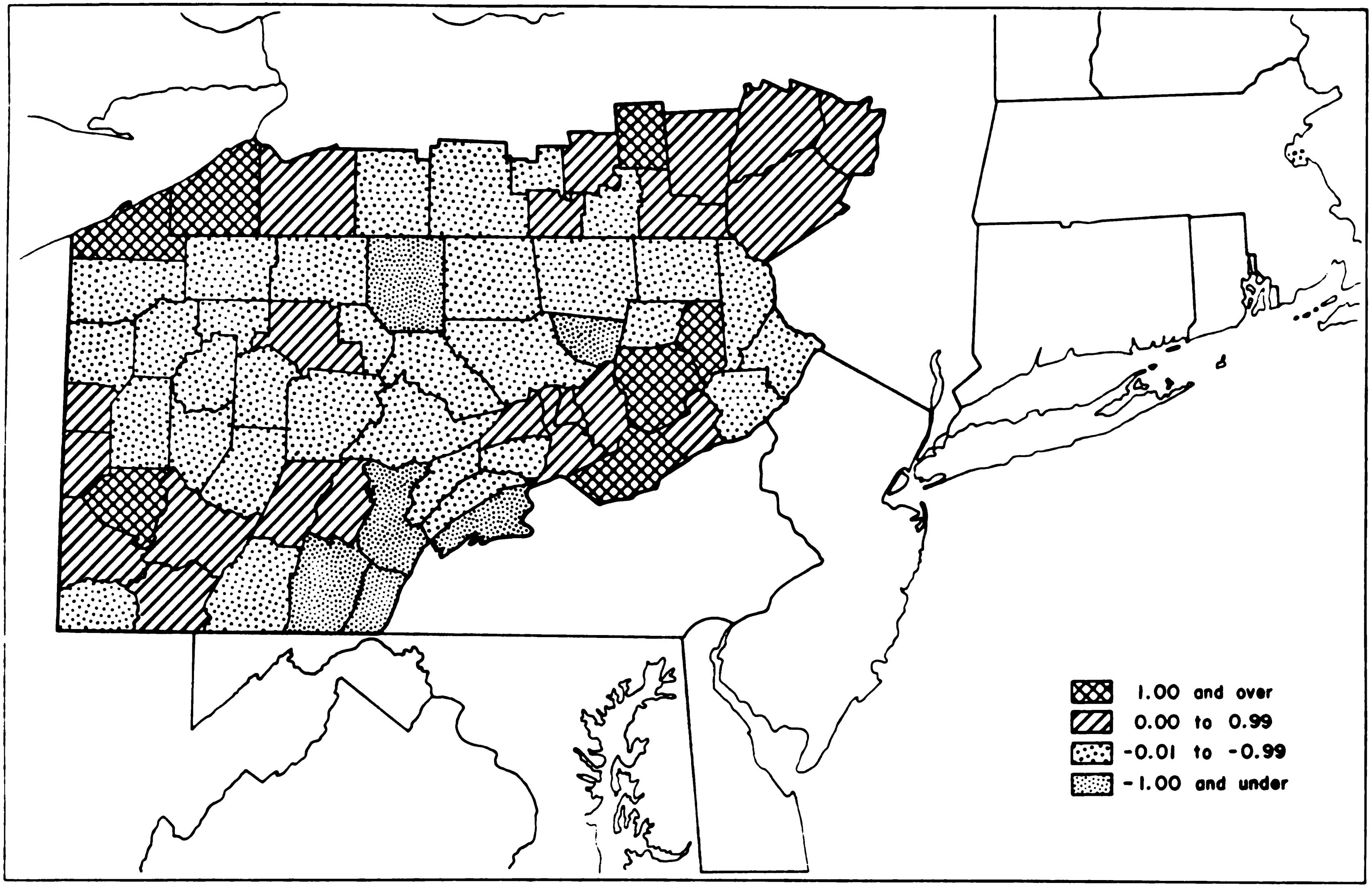

Fig. 15.--Areal Distribution of Component One Scores, Intensive Agriculture, 1909-1910.

investment is a very important agricultural characteristic at the beginning of this century as it explains nearly a third of the variation found in the collected agricultural data.

The cattle and/or dairy farming component in 1909-1910. The positive emphasis in the loadings on labor productivity, the percent of cropland that had hay harvested, and the expenditure for feed indicated a cattle and/or dairy emphasis (Table 12). With more than 28 percent of the total variance explained, this component was nearly as important an indicator of a dominant agricultural system as the principal component. An analysis of the areal patterns of the factor scores disclosed the areas of northeastern, south central, and southwestern Pennsylvania, the northern tier counties of Pennsylvania, and most of the counties of southern New York state as having positive values (Figure 16). The high values for most of the Appalachian counties of eastern New York suggested that this component was primarily a measure of the relative extent of dairy farming. In 1910 New York state led all states in dairy cow numbers (Fippin, 1921, p. 207). Low negative values, indicative of farming which was the complete opposite of animal raising were recorded for counties that had either a crop emphasis including vegetables and fruits, or a subsistence kind of farming economy. Counties that were particularly crop oriented included Northumberland, Schuylkill, Snyder, Union, Columbia, Montour, Lycoming, Carbon, and Luzerne and formed a cluster of counties in central Pennsylvania. Another group of counties with low values, north and northeast of Allegheny County and Pittsburgh, were possibly more subsistence based.

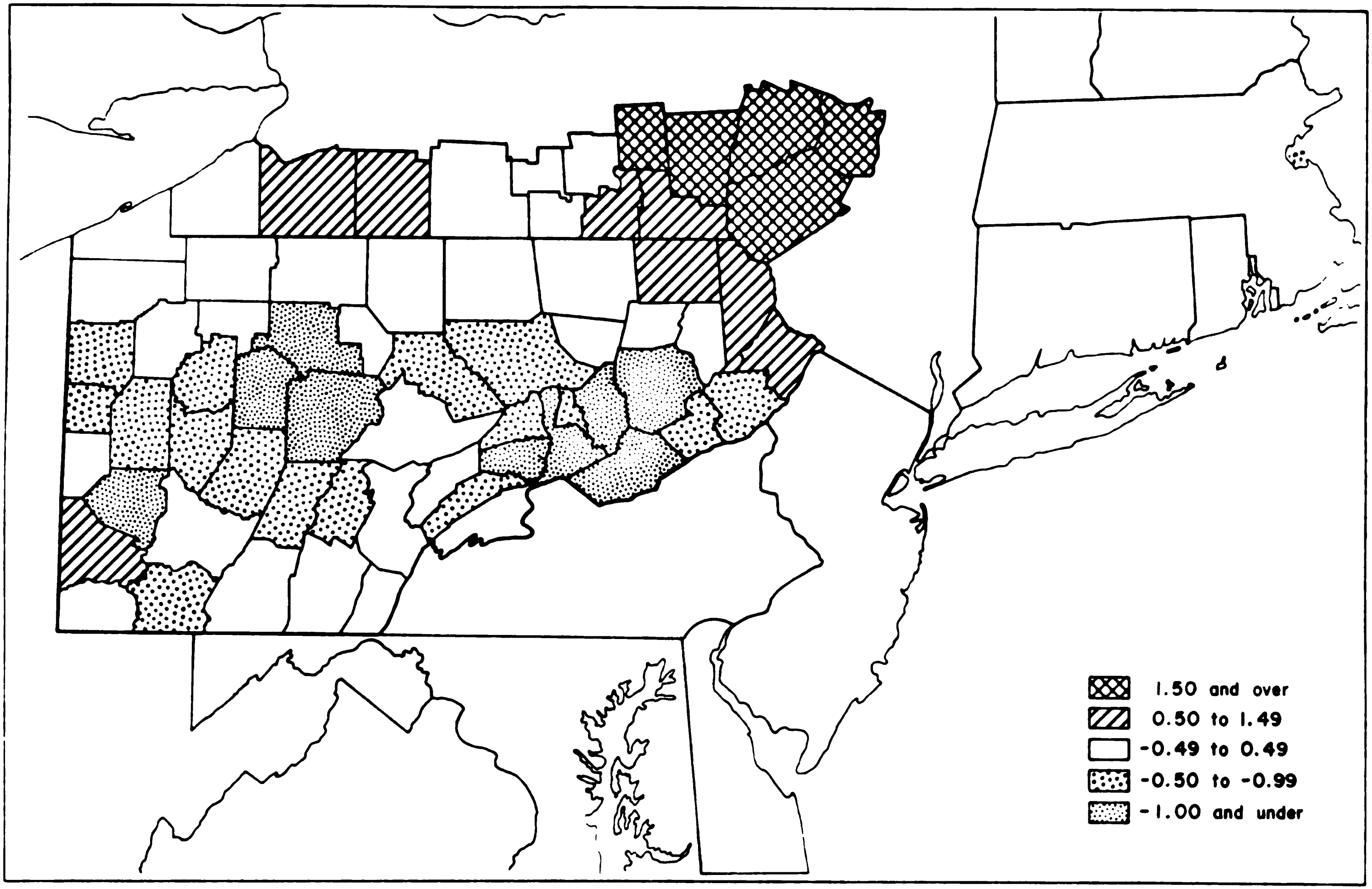

Fig. 16.--Areal Distribution of Component Two Scores, Cattle and/or Dairy Farming, 1909-1910.

<u>Cropland availability component in 1909-1910</u>. The third component accounted for about 17 percent of the variation of the agricultural systems data for 1909-1910. The one variable that correlated relatively high and positively with this composite variable was the percentage cropland harvested. As hay land is counted as cropland, the dairy counties of more than a half decade ago could have theoretically scored high on this measure. The positive component scores for the general dairying region of the New York part of the north Appalachians would indicate that the above observation is correct and of the cropland available most was harvested, presumably much in the form of hay (Figure 17). In Pennsylvania some of the counties that were to become major producers of dairy products had moderately high positive quantities as in New York state, but a few northeastern counties which were to become noted for dairying, e.g., Wayne, Wyoming, and Susquehanna had negative component scores; therefore, it is surmised that dairying had not gained much commercial status in these counties at that time. The high scores in certain central Pennsylvania counties represented intensive use of the lands in fertile valleys.

Some new practices in dairying occurred in New York at the beginning of the Twentieth Century. The transition from nearly full summer dairying to some production of milk during the winter to meet the increasing yearlong demands for fluid milk of the rapidly urbanizing Northeast required in addition to more grain feeding more and better roughage. The development and acceptance of the silo in the first and second decade of the 20th Century had much to do with making

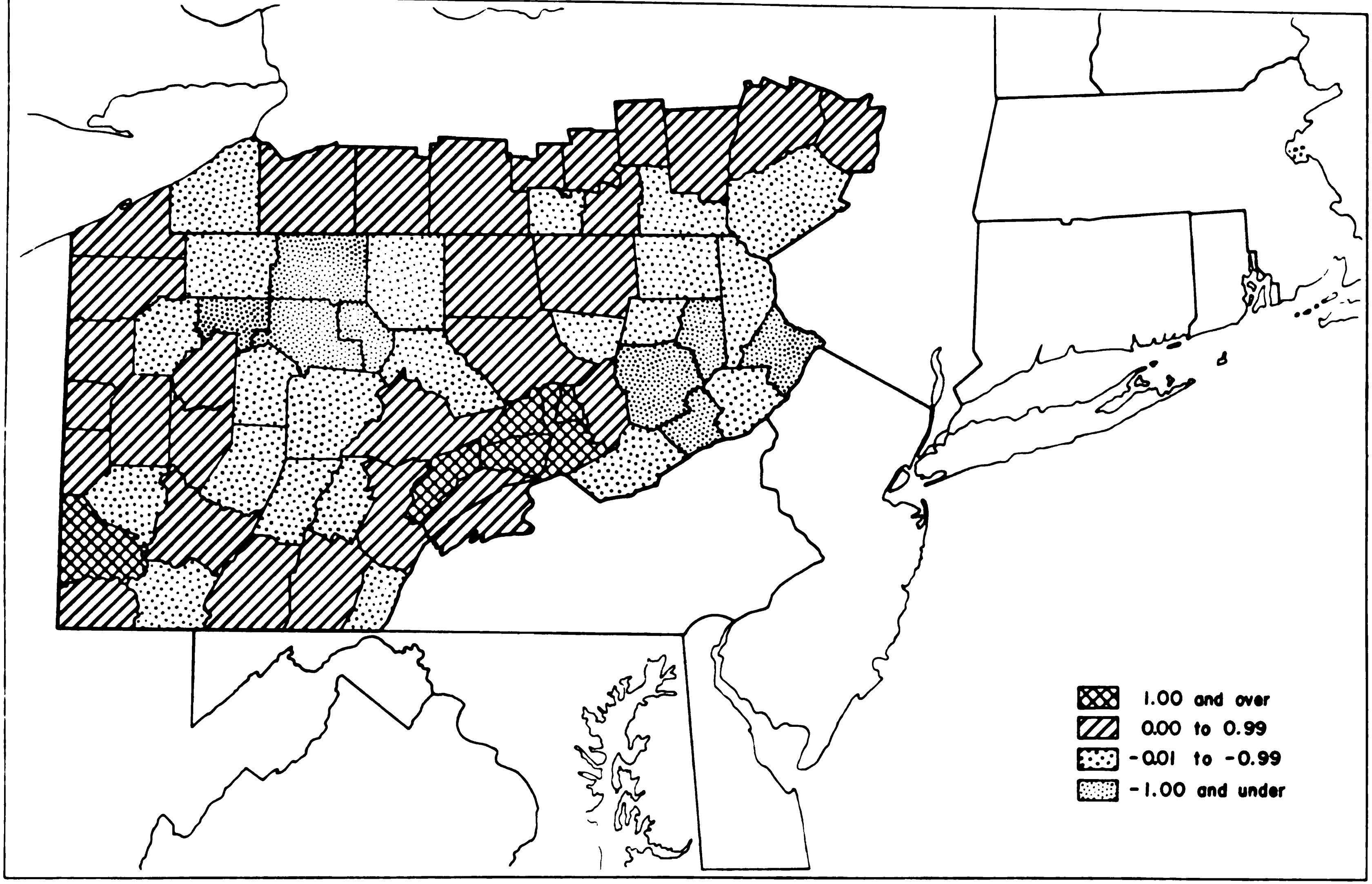

Fig. 17.--Areal Distribution of Component Three Scores, Cropland Availability, 1909-1910.

ie production of milk during the winter months feasible. Along with ie silo, which 40 percent of the farms in New York had in 1917, the eed for barns with large storage capacities in a long winter and oist climate partially sustained the high level of the cropland harested. General developments relevant to the more intensive use of ropland in dairying areas were well expressed at the time.

> A few farmers, especially those making the highest grade of milk and cream on tillable land, are inclined to reduce the pasture area and to depend almost exclusively on summer silos and soiling crops. There is an increasing tendency to supplement the late summer and fall pasture that is frequently short by the use of silage (Fippin, 1921, pp. 214-216).

It appears that the intensification of dairying in the Appalachian counties of New York was to some extent an adjustment to dairying changes occurring then in the Hudson Valley region and on Long Island due in part to the rapidly increasing urban population (Fippin, 1921, p. 213). This areal expansion of dairying effected northeastern Pennsylvania. As demand and preservation technology grew, New York City became the major natural market for milk produced in many of the nearby areas of Pennsylvania.

The Components of Agricultural Systems in 1929-1930

The four selected components explained about 78 percent of the total variance in the 1929-30 agricultural data. Because the data was more available for the chosen indices in 1929-30 than 1909-10 (21 as to 13 variables), the components extracted may contrast somewhat more with those of 1909-1910 than they would have otherwise; yet, with the advent of the tractor, the auto and the truck the need for gasoline, the great expansion in dairying, and the move to off the farm work, he findings were expected to show considerable changes in the agri-ultural systems and the components.

The principal component in 1929-1930. The high correlations ith the principal component that accounted for about 26 percent of he total variance were land productivity, value of hired labor, and ercent of farms reporting trucks (Table 13). From the high values of interrelationship between the first two variables and the component can be inferred and an intensive agricultural dimension. Traditional farming in Pennsylvania was extensive, i.e., in the use of land but even prior to the Great Depression some agricultural areas could be characterized by high average sales per acre, and the relative amount spent for hired labor. Certain types of farming could be ruled out as having this component. Dairying has been primarily a family business with labor supplied mostly by family members and it has had a high degree of labor productivity as it can be carried on throughout the year. As a matter of fact at this time there were few large animal-related farming operations which would have demanded wage workers. Thus, the principal component most likely was related to the intensity of crop production.

A separation of the component scores with emphasis on the counties with the positive values revealed an interesting urban relationship. Most all the high scores were found in the vicinity of the largest Pennsylvania cities, e.g., Pittsburgh, Scranton, Wilkes-Barre, and Erie (Figure 18), and the lower positive values in the outlying but adjacent locations. With the exception of three counties in south central New York agriculture of the New York portion of the study ɔle 13.--Major Loadings from the Principal Components Analysis of Agriculture, 1929-1930.

Positive Loadings ıriable	Loading	Negative Loadings Variable	Loading
	Component One: Intensive Agriculture		
and productivity	.85	Avg. size farm in acres	-.50
alue of hired labor	.84		
farms reporting trucks	.75		
ıvg. value of implements and machinery	.74		
ıvg. $ spent for gas	.74		
Ratio of farm expenditures to value of agricultural production	.68		
Avg. value of land and buildings	.60		
Farm persons/100 acres	.57		
Avg. expenditures for feed	.55		
Avg. expenditures for fertilizer	.50		
Explained Variance	25.90%		
	Component Two: Dairying		
Labor productivity	.93	Farm persons/100 acres	-.72
% farms that are dairy	.86	% farm operators working 100 days off the farm	-.71
Avg. size farm in acres	.71		
% cropland harvested	.64		
% harvested cropland, hay	.57		
Avg. cropland per farm	.54		
Explained Variance	23.80%		
	Component Three: Self-Sufficing Farming		
Pastureland-cropland ratio	.79	Avg. cropland acreage	-.76
% harvested cropland, hay	.72	% farms reporting tractors	-.67
		% farms reporting autos	-.63

le 13.--Continued.

Positive Loadings		Negative Loadings	
riable	Loading	Variable	Loading
tio of farm expenditures to value of agricultural production	.51		
xplained Variance	16.40%		
Component Four: Part-Time Farming			
vg. value of land and buildings	.55	Avg. expenditures for fertilizer	-.80
		Avg. expenditures for feed	-.69
		Avg. value of implements and machinery	-.66
Explained Variance	11.50%		

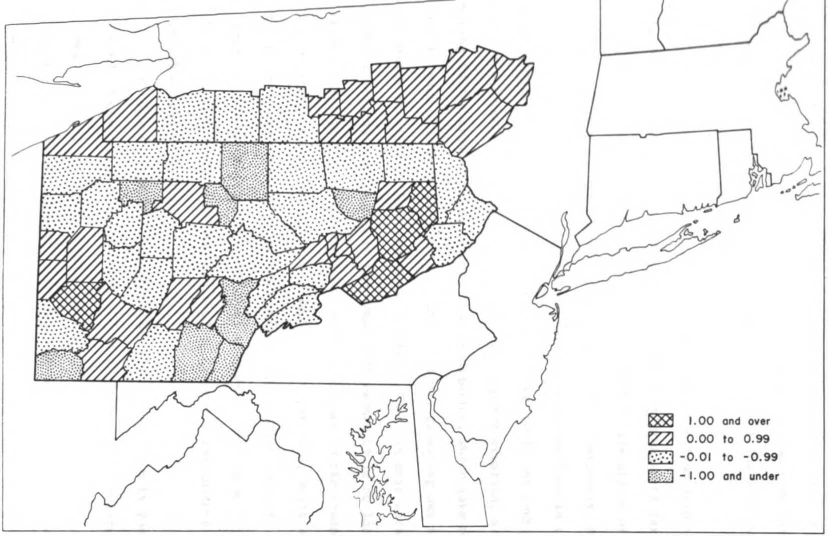

Fig. 18.--Areal Distribution of Component One Scores, Intensive Agriculture, 1929-1930.

gion was generally and moderately affected by the principal com-nent. This latter finding is not surprising as this most northern rt of Appalachia has been and continues to be one of the most overall banized sub-regions of Appalachia.

With the rapid buildup of the urban population from 1910 to 930, a development much contributed to by the outmigration of farm eople, a urban way of life came to be basic to the life styles of an ever greater proportion of the Region's population. Previously, a large segment of the population raised most of their own food in the rural areas, but many of these persons did not and could not continue their own production of food, gardening, and food preservation, after moving to the crowded urban places. Suburbanization, which gave more land to each residence had yet to occur. Besides, gardening was a low status practice in American urban society. Thus, in part because former rural and farm people in the urban settlements could no longer raise a large part of their own food, major increases in the demands for perishable food products, i.e., especially vegetables, built up in the immediate areas of these much enlarged population centers. Therefore, the urban orientation of this component and related factors strongly indicated that one kind of intensive agriculture in 1929-30 was market gardening.

The identity of this component is further supported by Von Thünen's theory and additional facts. "The activity with the largest 'amount of output per acre' has the steepest rent gradient and is located closest to the market . . ." (Hoover, 1971, p. 105). Because the land is expensive and has high rates of taxation, very intensive iculture is practiced including ". . . the growing of several quick-uring vegetables in succession on the same plot within a single ason . . . ." Daily deliveries of fresh vegetables, berries, small uits, etc. in season can be made over a short distance at signifi-nt transport cost savings and with the convenience of truck ownership. The extent of such 'market gardening' districts tends to correspond o the size of the urban population served" (Thoman, Conkling, and eates, 1968, p. 136).

A study of the predominate and second types of farming in 1929 based upon sources of income and maps by township level illustrated patterns of truck, fruit, and crop specialty types of farming that primarily coincide with the location of the highest positive factor scores. Nursery and greenhouse products alone made up seven percent of the total value of crops in Pennsylvania, exceeding the values of vegetables (Rauchenstein and Weaver, 1934, pp. 44-47); and thus, should be regarded as additional types of intensive agriculture and part of the principal component.

A logical question arose as to why intensive agriculture was chosen as the principal component when in fact it was quite atypical of the region's agriculture. Some forms of dairying, especially those with a minor dependence upon pasture, may be regarded as possessing intensive agricultural characteristics, and probably some of the data of dairying located adjacent to the largest cities of the study area helped to raise the importance of this component. Because intensive agriculture was quite unlike the general nature of most of the farming of the Region, it could be rationally expected to account for much of the variation found in the data.

The dairy farming component in 1929-1930. This second chosen component explained almost 24 percent of the total variance in the agricultural data and in that respect was nearly as important as the principal component in synthesizing the differences in the agriculture of the period. Because of the kind of variables associated with this component, the interpretation was easily obtained and concluded to be dairying (Table 13). A dairying component evolved in the 1909-10 agricultural data also and had similar associated variables. As in 1909-10, the following variables were related to the dairying component: labor productivity, percent cropland harvested which was hay, average size of farm in acres, and farm persons per 100 acres. A major addition in 1929-30 was the association of the percent farms that were dairy with the component, leaving very little doubt that the component was in fact dairying. Two additionally associated variables with dairying gave some insight into areas where dairying predominated. A major part of the cropland harvested, grew hay. Few dairy areas had farmers working 100 days or more off the farm. The relatively low level of off the farm work engaged in by dairymen permitted farmers to use most of their time in agriculturally related production activities which credited them with a high measure of labor productivity.

A comparison of the 1909-10 and 1929-30 component scores exhibited a strengthening of the importance of dairying in the agriculture of northeastern Pennsylvania and a changing to positive scores for a number of central Pennsylvania counties (Figure 19). In 1934

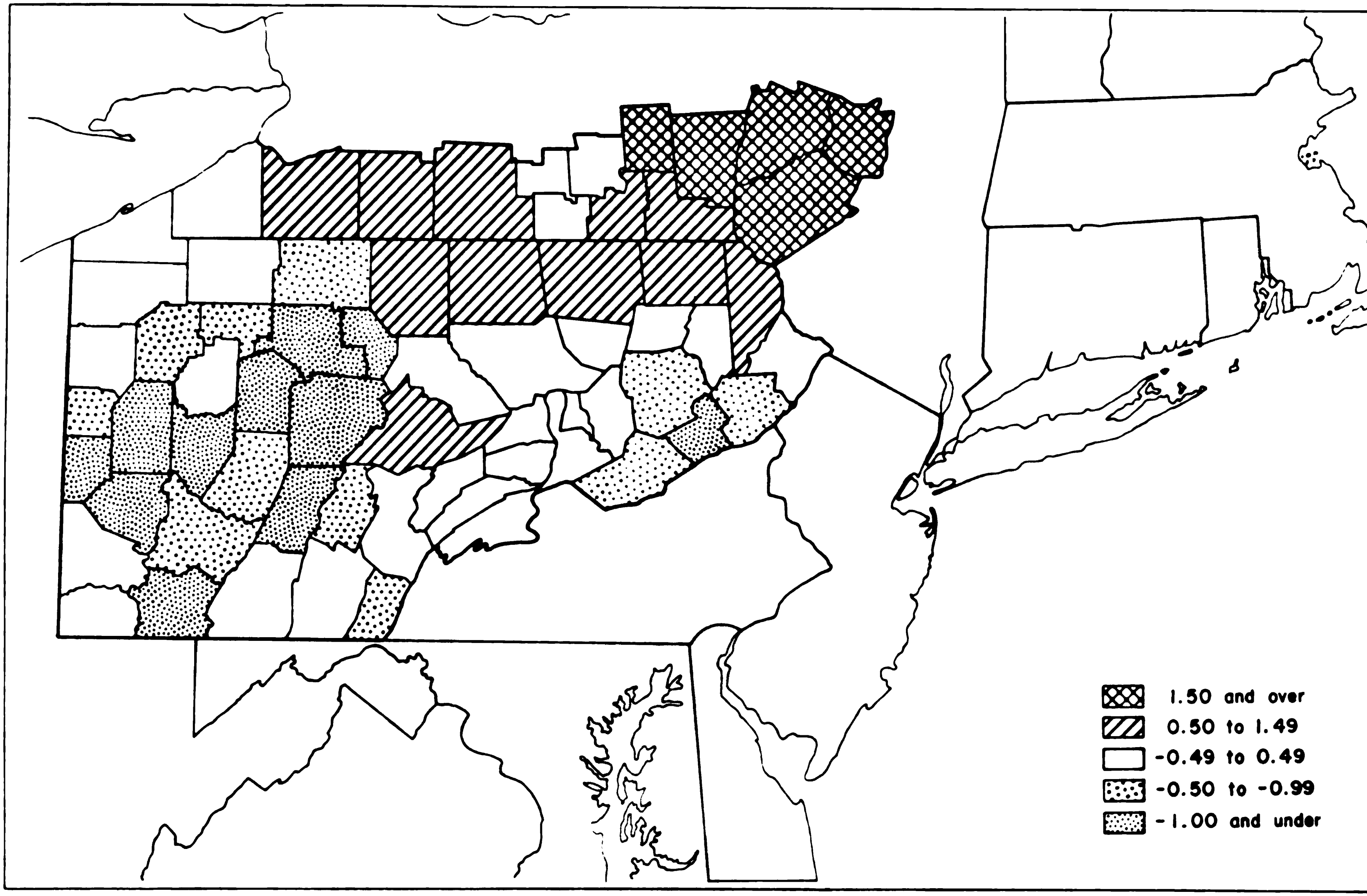

Fig. 19.--Areal Distribution of Component Two Scores, Dairying, 1929-1930.

nearly half of the country plants of central Pennsylvania shipped milk chiefly to New York City whose milk shed was growing further away from the city (Cowden and Fouse, 1936, pp. 9 and 28). Dairying declined slightly and relatively in western Pennsylvania where compared to the northeastern part of the State it was of minor importance. The position of dairy changes in southern New York was mixed as the more urban counties had lower scores and the more rural counties had higher scores component than in 1909-10. The spatial pattern of component scores suggested a buildup of dairying in rural counties where there were access agricultural resources.

An explanation for the locational and quantitative changes in dairy-farming up to 1929-30 would constitute a large part of the Region's agricultural history and geography and would contribute to understanding the farm population changes in the northern Appalachians. The dairy farm operator has utilized labor rather intensively while land has been used rather extensively (Durand, 1949, p. 7), although the latter practice has tended to decline. As early as pre-Civil War times in the hill country of New York, considerable evidences of rural decline were to be seen and it was stated, "sheep raising and dairying, which required large acreage, crowded out small farmers" (Ellis, Frost, Syrett, and Carman, 1967, p. 277).

Dairy farming needed additional land even during its rudimentary and initial stages of development. Perhaps the expanded land requirements of dairying particularly accounted for the relatively late occurrence of the high point of improved land acreage in the hill counties of New York and Pennsylvania about 1900. The "country population" also reached generally its maximum in these counties about at this time (Baker, 1921, pp. 29-30). Presumably as dairy farming grew larger and more into a commercial enterprise, more selectivity in types of land was practiced, e.g., pastured woodland became less desirable. By 1910-20 the East had observable and general decreases in farm land and especially in New England and the Middle Atlantic states there occurred a significant reduction in the arable land (Baker, 1923, pp. 18-20). Some of these decreases, however, were the result of rapid urbanization within the Northeast and the competition of agricultural products produced from new agricultural lands in the West. Nevertheless, about half a dozen counties in Pennsylvania having increases in land in farms or improved land in farms from 1910-1920 were major dairy counties of the northern tier, northwest, and center of the State. Some counties on the fringe of the dairy hearths had farm land increases as late as from 1910 to 1920. Thus, dairy farming occupied a niche where there were comparatively surplus land resources for which previously there were no or limited agricultural uses, e.g., woodland pasture; but after this agricultural system of dairying was established, rapidly expanding urban markets demanded an increase in the dimensions of the dairying operations through the intensification of the use of arable land. The relative use of and demand for more cropland and feed, both for forage and grains to increase milk production, led to farm consolidation, the displacement of small-time farmers, and the abandonment or selling of non-tillable land to nonfarmers. Yet, the trend toward dissociation of crop growing from animal raising continued.

In the fifty years prior to the study period, dairying activities primarily produced butter and cheese products, particularly at locations away from urban centers, and some fluid milk was marketed from production areas situated very near the towns and cities. Some poor quality milk for New York City came from cows kept within or very near the city, fed the swill of distilleries, and housed under very unhealthy conditions (Ellis, 1967, pp. 274-275). During the half century before 1900, New York State was the Nation's leading dairy state, ranking first in the total production of cheese and butter during the fifty years. Pennsylvania held second position in total butter production. Yet, agriculture was ". . . undergoing fundamental changes as a consequence of new forces." One force was the competition of western agricultural production. Other forces were the significant expansions of commercial and industrial economic activities coinciding somewhat with major urban population growth. The urban population had to be fed and agriculturalists were compelled to adjust their farming systems both in type and method. The farmers were influenced by the monetary benefits accruing from the comparative advantages of raising or producing specialized and perishable products, e.g., vegetable, fruit, poultry, and dairy, for the nearby and rapidly growing urban markets. Consequently, prior to the study period, a shift had occurred in the nature of the end product of dairying, from butter and/or cheese to fluid milk (Brunger, 1955, pp. 136-138).

The two forces which particularly brought about large increases in the production of fluid milk were the absolute and relative expansion of milk consumption and the modernization of transportation, i.e., the evolution of the railroads. Within the New York-New Jersey metropolitan area between 1900 and 1920 total consumption doubled, and from 1900 to 1950 consumption grew by four times, although decreases were recorded in the middle thirties and the late forties. Most of this increase was due to the urban population growth, but an important contribution to the increases were made through higher consumption per capita, e.g., the 1950 per capita sales were 50 percent larger than in 1900 (Froelich, 1954, pp. 5183-5184). There were important increases in the relative consumption of milk due to the various technological developments, including improvements in transportation, the inventions of tinware, glass milk bottles, and the use of sanitary methods--all of which contributed to the improvement of milk quality (Pirtle, 1926, p. 139).

The self-sufficing farming component in 1929-1930. The third selected component of agriculture on the eve of the Great Depression explained more than 16 percent of the total variance in the agricultural data matrix. The variables most associated with this component were measures of land use (Table 13). As the value of the component increased the pasture acreage relative to the cropland increased. The more agriculture could be characterized by the component, the less the cropland available of that existing was harvested, and more of crops gathered was hay. Of major assistance in the identification of this new index of farming during 1929-30, was the negative relationship of tractors and automobiles, suggesting that these farms were for the most part unmechanized, semi self-dependent, and removed from the major technological developments in agriculture. Thus, the component very likely referred to noncommercial farming. At this time there were few between general farming and self-sufficing agriculture as mechanization was minimal compared to subsequent times.

The positive component scores were located in two contrasting areas: the urban counties and the most rural, agricultural, and/or isolated counties (Figure 20). A study of Pennsylvania farming types at about this time had maps that displayed large areas of the more isolated counties as depending upon self-sufficing farms either primarily or secondarily, e.g., in such counties as Forest, Elk, Cameron, Clearfield, McKean, and Warren; all of these had positive component scores and were located within the Allegheny Mountain region. Other areas said to have had self-sufficiency farming and which had positive component scores were extreme southwestern Pennsylvania, the northern anthracite coal mining counties of Lackawanna and Luzerne, and the Catskill-Pocono summer resort area of northeastern Pennsylvania (Rauchenstein and Weaver, 1934, pp. 46-47 and 50). Delaware County located partly in the Catskill Mountain area in New York State, much like the Pennsylvania Pocono region economically, had the highest score in New York and adjacent Chenango and Otsego counties also had positive values. Mostly the coal and forest areas in Pennsylvania could be characterized by semi-subsistence farming in 1929, and this in part can account for the self-sufficiency characteristics in the remaining northeastern Pennsylvania counties. The situation of these counties between two large urban metropolitan areas, the Anthracite Valley (Scranton, Wilkes-Barre, and many smaller cities) and The Triple Cities (Binghamton, Endicott, and Johnson City) may explain the

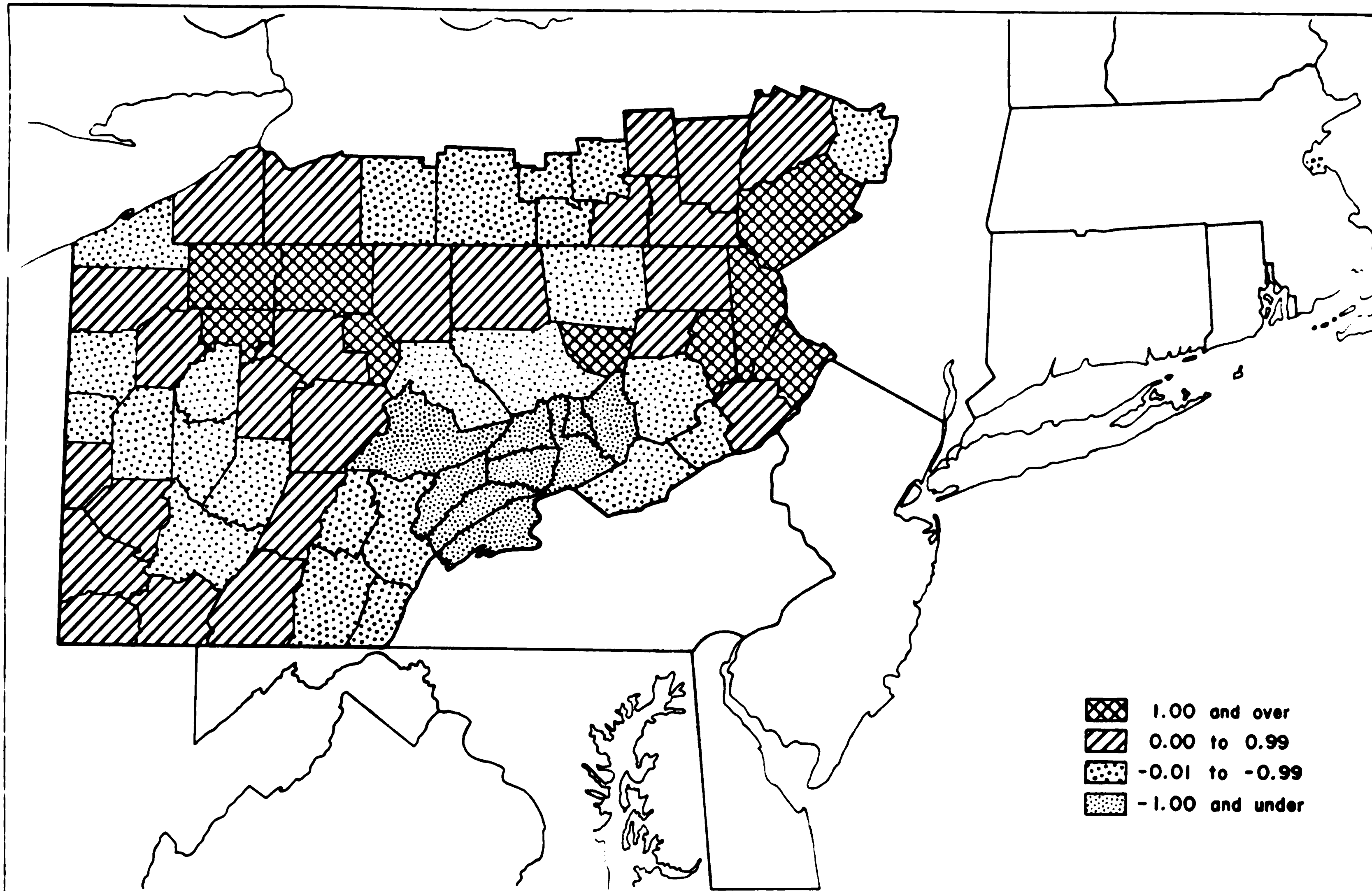

Fig. 20.--Areal Distribution of Component Three Scores, Self-Sufficing Farms, 1929-1930.

maintenance of some small and noncommercial farms. Coinciding with the Depression years there was a surprising wide published advocacy of small holdings and subsistence homesteads and of their existence in and near the cities (Bercaw, 1934). Thus, the positive values in urban counties and adjacent counties presumably were caused by the numerous unemployed or low wage industrial workers who took to the available local lands to raise part of their food.

<u>The part-time farming component in 1929-1930</u>. The fourth and last component selected for 1929-30, explained more than 11 percent of the variation in the agricultural data. On the basis of three kinds of evidence, the associated variables, the component scores, and the literature, <u>part-time farming</u> was thought to be the component.

Variables correlated negatively with the component and depicted an increasing kind of farming with a decreasing use of fertilizer, feed, and machinery (Table 13). A moderate positive relationship existed between the component and the average value of land and buildings. The individuals who would engage in off the farm employment have done so much of the time because of farm poverty and the need and drive for a supplementary job; yet, this effort has often not been sufficient to raise a part-time farmer's total earnings to those of the full-time farmer (Morrill and Wohlenberg, 1971, p. 90). Because of the need to work off the farm, few of the part-time farmers had the capital to invest in machinery, fertilizer, and/or to buy feed. Apparently, however, most of these farmers owned the land and buildings of their residence.

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Part-time farming was an important characteristic of the counties containing the largest cities of the region. These urban counties with high positive component scores were: Allegheny, Erie, Luzerne, Broome, and Chemung. Lackawanna County had an inexplicably high negative score, but self-sufficient farms were of significant importance in the county. The differences in these farming components for Luzerne and Lackawanna counties, when in many ways because of the anthracite coal mining, they had more comparisons than contrasts, is difficult to reconcile unless the data is deficient. Clusters of semi-rural counties surrounding Pittsburgh in southwestern Pennsylvania, Binghamton and Elmira in New York State accounted for most of the remaining positive scores and the major areas of part-time farming. Minor degrees of part-time farming were present in the Pocono-Catskill recreation and resort area and also in northwestern and southwestern New York. Because of the close association of part-time farming to places within close proximity to the larger cities of the Region, the areas of part-time farming were generally located within easy commuting distances, given the roads and vehicles of the time, and in places near the large cities where large industries were concentrated or in places with a heavy orientation toward either recreation or specialty crops where off the farm employment by the day was easily obtained.

The rise of part-time farming was a very important adjustment in United States agriculture; yet, agricultural and economic geographers with few exceptions (Alexander, 1963, p. 212) have given only the most meager attention to part-time farming which is an important general type and system of farming. Agricultural economists however extensively researched the topic in the 1930 decade (Hennefrund, 1939). A review of the significant pertinent research of these years concluded:

> . . . part-time farming has come to be regarded, not merely as a depression phenomenon nor as just a minor and abnormal type of farming, but as a significant part of our rural economy--a mode of living that has a long history and one that will become increasingly important in the future (Salter and Diehl, 1940, p. 581).

Other writers also stated that part-time farming has had a long history. Hood wrote:

> The part-time farmer is by no means a product of the twentieth century. . . . part-time farming is as old as civilization itself. . . . history is replete with the examples of people who obtained a portion of their income from the farm and a portion from some other occupation (Hood, 1935, p. 67).

John, a rural sociologist, referred to the tradition of part-time farming in Pennsylvania when he introduced his study's findings as follows:

> Although part-time farming has been carried on in Pennsylvania for many years, little attention was paid to its social significance or to its specific contributions until the depression of 1929 to 1934, when many leaders in industry and in government became interested in part-time farming for families faced with irregular employment (John, 1938, p. 1).

Geographers belatedly gave limited attention to off the farm employment of farm operators perhaps because rural sociologists and agricultural economists first chose the topic as a major interest. A few geographers briefly noted some part-time farming existing shortly after 1900. In some parts of New England many small part-time farms were carved out of former farms and became the residences of the newer European immigrants; the women and children of those families farmed intensively, grew gardens and berries, and raised poultry while the man of the family helped some but was generally factory employed w

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(Miller and Parkins, 1928, p. 110). For the central and southern part of the Appalachian Plateau, especially in southern West Virginia and eastern Kentucky, it was said, ". . . lumber companies began to come in and give part-time employment to the mountain farmer, and here and there coal mines were opened" (Smith, 1937, p. 148). Part-time farming was associated with recreation in New England (Greeley, 1942).

As information on the nonfarm employment of farm operators was first collected by the Census of Agriculture in 1930 (Fuguitt, 1959, p. 375), the state of off the farm employment is unclear previous to this date. As work was provided by local industries, recreational activities, lumbering, and the extraction of various minerals, and these were all important economic activities in Pennsylvania and perhaps to a lesser extent in New York, part-time farming was an important feature of agriculture of certain areas of the northern Appalachians before 1930. Pennsylvania has long been known for its large production of bituminous coal and the center of the iron and steel industry. As much of Pennsylvania is within the United States "manufacturing belt," dispersed factories have provided jobs for many small-time farmers. As of 1970, and based upon land area, Pennsylvania led all other states in the value of cumulative past production of mineral resources since 1911 (Griffiths, 1970, pp. 13-14); thus much potential employment has existed in the mineral extractive activities. The Catskill Mountain area of New York and the Pocono Plateau of Pennsylvania both in the northern Appalachians had many summer resorts (Smith, 1937, p. 143) which provided off the farm working opportunities for farm people. The manufacturing cities of

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Binghamton, Johnson City, Endicott, and Elmira presented nearby employment in industries for many farm people. A map of part-time farms in 1930 revealed heavy concentrations of these farms in extreme western Pennsylvania, southwestern New York, and the area of the above mentioned manufacturing cities in south central New York (Smith, 1937, p. 27).

Why should have part-time farming suddenly taken on the prominence such that data was gathered by the Bureau of the Census in 1930 and many studies on the topic were carried out in the 1930s? This farming seems to have become significant right after the end of World War I, but it gained its greatest growth during the 1930s with the "back to the land movement" of many city dwellers who were unemployed and/or in financial trouble. Also, before the 1920s the long hours of factory work made work off the farm nearly impossible for many farmers, plus the necessary transportation was not available until the coming of the hard-surfaced road and the automobile or an alternate cheap means of transport (Hood, 1935, p. 67).

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CHAPTER 6

ANALYSIS OF THE COMPONENTS OF AGRICULTURE: SOME DOMINANT CHARACTERISTICS AND SYSTEMS OF FARMING IN THE NORTHERN APPALACHIANS, 1949-1950

Identification of the Region's Agricultural Components

As for the 1909-10 and 1929-30 eras, it was necessary to identify the main characteristics and types of agriculture and the areal extent of these major features of farming for the 1949-50 time period. Again, it was hypothesized that some of the differences in the geographical distributions of these major features would be associated with the areal variations in the farm population declines. A comparison of the components composing agriculture in 1949-50 with those of 1969-70 in the subsequent chapter was expected to illustrate in general the changes in farming between 1949 and 1970. These agricultural and spatial data after being interpreted and described in this chapter are tested as possible foundations for explanations and theories of farm depopulation in Chapter 8.

The Components of Agricultural Systems in 1949-1950

Five components were extracted from the 1949-50 agricultural variables. These components explained nearly 83 percent of the total variance of the agricultural data (Table 14). From 1930 to 1950 the agriculture of the northern Appalachians became ever more commercially oriented as the small farmer increasingly experienced a more difficult time competing effectively in the market place and attempting to pay his fixed costs; thus, some farmers became part-time farmers. The commercial farmer, of course, became much more dependent upon others for many of the necessary inputs of his specialized farming. The use of off the farm resources was expected to be a major component of this time.

The principal component in 1949-1950. In the previous time period, dairying and part-time farming were two components which if they had been considered together would have explained more than 35 percent of the variance in the agricultural data. In 1949-50, associations of certain variables with the principal component revealed dairying and part-time farming grouped dichotomously together (Table 14). The component was therefore called the dairying and part-time farming dichotomy ratio, and it accounted for more than 31 percent of the variance in the 1949-50 data. Briefly this component illustrated that dairy farmers generally participated only very limitedly in part-time farming. The relatively high positive association of the percent of the farms which were dairy with the ratio of dairy farms to part-time farms and the high negative correlation of 100 days off the farm work with this ratio indicated the near full-time work dairying presented to a farmer. These two major dimensions of the component existed because where dairying characterized much of the farming, part-time

Table 14.--Major Loadings from the Principal Components Analysis of Agriculture, 1949-1950.

Positive Loadings: Variable	Loading	Negative Loadings: Variable	Loading
Component One: Dairying and Off-Farm Work Dichotomy Ratio			
Labor productivity	.90	% farm operators working 100 days off the farm	-.89
% of farms, dairy	.81	Farm persons per 100 acres	-.72
Avg. cropland acreage	.78		
Avg. expenditures for feed	.76		
Avg. size of farm in acres	.73		
Avg. $ spent for gas	.72		
Explained Variance	31.38%		
Component Two: Capital Intensive Agriculture			
Avg. value of implements and machinery	.93	Pastureland-cropland ratio	-.75
Land productivity	.60	% harvested cropland, hay	-.73
Avg. value of land and buildings	.60	Avg. size of farm in acres	-.56
% farms reporting tractors	.58		
Avg. expenditures for fertilizer	.58		
Farm persons per 100 acres	.57		
Avg. $ spent for gas	.51		
Explained Variance	23.47%		
Component Three: Labor Oriented Agriculture			
% farms reporting trucks	.66		
Value of hired labor	.66		
Avg. value of land and buildings	.59		
% harvested cropland, hay	.55		
Land productivity	.54		
Avg. expenditures for feed	.49		
Explained Variance	15.47%		

Table 14.--Continued.

Positive Loadings Variable	Loading	Negative Loadings Variable	Loading
Component Four: Residential Farming			
Ratio of farm expenditures to value of agricultural production	.56	Corn yields	-.50
Explained Variance	6.99%		

agricultural activities were minimal and where part-time agriculture was important, dairying was of minor importance.

The associations of certain variables with the principal component gave strong support to the above interpretation. Labor productivity with an r of .90 was the highest correlation. As noted earlier in this study, high levels of labor productivity correlated with dairying; therefore, this variable undoubtedly belonged to dairying, which was represented as the second highest positive related variable with an r of .81. Additional moderately related positive variables were: average cropland acreage, expenditures for feed, and average size of farm in acres--all of these previously correlated rather closely with dairy farming, and therefore suggested a partial dairying label for the component. The moderately important gasoline variable depicted the increased importance on dairy farms of mechanization.

The areal pattern of the counties with the highest positive component scores coincided with the major dairy subregions of the northern Appalachians: northeastern Pennsylvania, central Pennsylvania, and the southern tier of New York State (Figure 21). Most of the counties of western Pennsylvania had negative scores, suggesting the relative less importance of dairying in much of the western portion of the Appalachian Plateau in Pennsylvania. Although dairying was the most important source of farm income in the western third of Pennsylvania, the counties north and adjacent to Pittsburgh and Allegheny County recorded significantly lower numbers of dairy cows during the 1930s and through the mid-1940s (Kimmel, 1950, pp. 126-131). In the

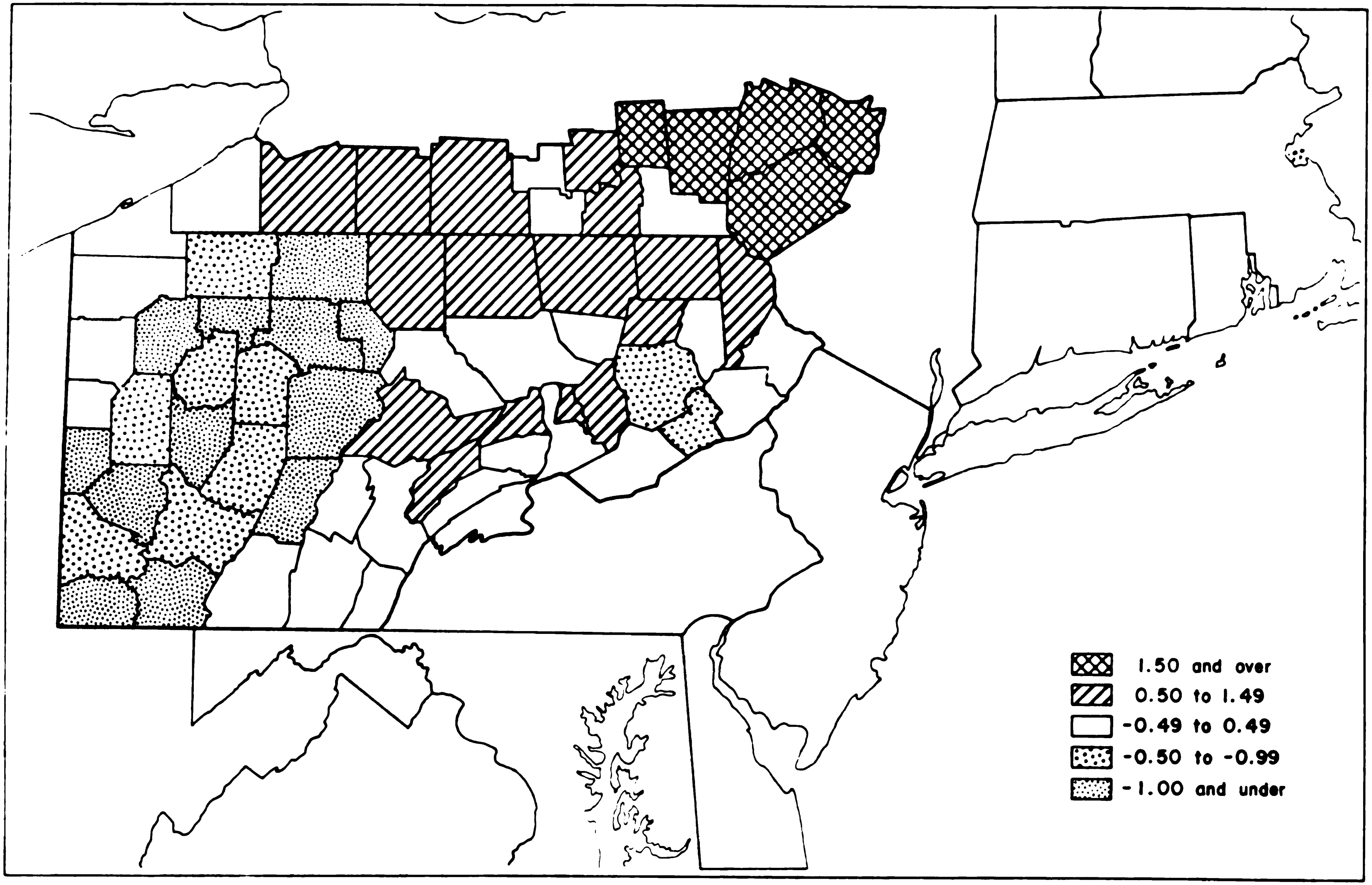

Fig. 21.--Areal Distribution of Component One Scores, Dairying and Off Farm Work Ratio, 1949-1950.

post World War II period for a few years, an increase in dairy cow numbers occurred in southwestern counties of Pennsylvania, south of Pittsburgh (Table 15).

With the suburban expansion of Pittsburgh, dairying was presumably displaced from the more immediate areas of the city and outlying parts of counties had the opportunity to increase dairy herds. The general expansion of dairying south of Pittsburgh and the decline of dairying north of the city could perhaps be partly related to the subregional change in bituminous coal mining, the production of which shifted from the south to the northern area (Figure 22). It was observed for an earlier time that the "sudden accretion of wealth" from coal mining, oil, gas, and mineral leases in western Pennsylvania led many farmers to neglect proper management and utilization of their agricultural resources, including the land, some of which as a consequence has been abandoned (Miller and Parkins, 1928, p. 115; Murphy, 1937, pp. 470-471). Therefore, probably a surplus of unused agricultural resources, e.g., land, came available in southwestern Pennsylvania as coal strip mining decreased; whereas, in the area north of Pittsburgh increased mining activities led to an expansion of leases on agricultural lands. A necessity for successful dairying is a dependable source of nonpolluted water, another vital agricultural resource which was without doubt adversely affected by "acid mine drainage."

Expansion of part-time and other farms. As the principal component for 1949-50 had a high negative correlation with percent of farm operators working 100 days off the farm (r = -.89), negative component

Table 15.--Number of Commercial Dairy Herds in Pennsylvania, 1950-67.[a]

Year Beginning January 1	Milk Shed Area Pittsburgh	New York	Philadelphia	State
	Number of Herds			
1950	16,100	12,800	22,500	51,400
1951	15,500	12,700	22,300	50,500
1952	14,300	12,400	21,900	48,600
1953	13,900	12,000	21,300	47,200
1954	13,700	11,900	21,000	46,600
1955	13,200	11,800	20,700	45,700
1956	12,600	11,500	20,300	44,400
1957	11,500	11,200	19,500	42,200
1958	10,600	10,700	18,600	39,900
1959	10,100	10,200	17,900	38,200
1960	9,620	9,600	17,080	36,300
1961	9,220	9,210	16,370	34,800
1962	8,970	8,940	15,990	33,900
1963	8,360	8,460	15,180	32,000
1964	7,835	7,935	14,230	30,000
1965	7,320	7,410	13,270	28,000
1966	6,610	6,465	11,925	25,000
1967	5,850	5,850	10,300	22,000

[a]Refers to all Pennsylvania farms with 10 or more milk cows.

Source: Pennsylvania Crops and Livestock Annual Summary, 1966, C.R.S. 36, p. 15.

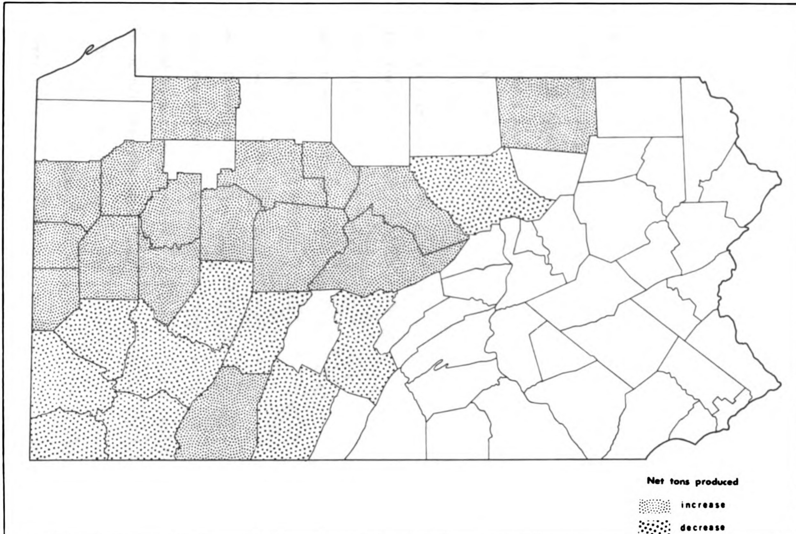

Fig. 22.--Locational Change in Bituminous Coal Strip Mining in Pennsylvania, 1944 to 1959.

scores would be expected in areas of high rates of part-time farming. Indeed, in western Pennsylvania most counties had negative component scores and this part of the State had on the average the highest rate, e.g., 40 percent and more, of farm operators working 100 or more days off their farms in 1949. This parameter of part-time farming however did not reflect the considerable numbers working a few days off the farm. Also, the intensity and impact of off the farm employment, especially in western Pennsylvania, and in other parts of the Region was considerably greater than portrayed only by "100 days or more of work off the farm" (Table 16).

For a more complete assessment of the influence of off the farm work, some classification and measurement of the "outside employment" of a degree less than that required for characterization as part-time farming is a necessity in an area as economically developed as the northern Appalachians. An inherent assumption at this juncture is that all off the farm work represents an important general mechanism of adjustment to changes in the agricultural systems.

There are many possible combinations of farming and off the farm jobs, a fact the significance of which has been belatedly recognized. Therefore, to more fully understand the effects of these various employments on farm work and thus on farm population change, it would be necessary to know several kinds of information: (1) the types of off the farm work engaged in by members of a farm family, (2) the relative and absolute amounts of each of these types, and (3) the varied locational distribution of each type. Obviously most of these tasks are beyond the scope of this research work; however,

Table 16.--Percent Farm Operators Working Off the Farm 100 or More Days, 1950-1960.

Counties	1949-50 Percent	1959-60 Percent	1969-70 Percent
Pennsylvania	38.0	39.1	44.0
Allegheny	51.2	41.6	45.4
Armstrong	43.5	45.0	56.8
Beaver	56.3	57.3	58.4
Bedford	32.9	36.8	40.8
Blair	44.7	35.4	34.1
Bradford	27.6	33.8	35.8
Butler	44.9	47.9	54.7
Cambria	51.6	46.1	57.2
Cameron	51.1	63.9	82.1
Carbon	50.4	46.6	52.3
Centre	32.0	31.0	37.1
Clarion	41.5	42.5	46.2
Clearfield	49.7	47.9	46.8
Clinton	35.1	38.6	45.4
Columbia	35.9	39.3	55.1
Crawford	39.4	46.2	49.0
Elk	50.8	56.9	57.8
Erie	46.1	43.5	48.9
Fayette	45.5	42.1	47.6
Forest	49.2	52.7	33.3
Fulton	27.1	38.0	45.1
Greene	41.9	46.7	54.6
Huntingdon	36.1	36.3	41.1
Indiana	41.0	44.2	49.2
Jefferson	41.9	41.4	48.1
Juniata	34.3	34.9	41.9
Lackawanna	29.9	32.8	35.9
Lawrence	42.7	46.2	50.8
Luzerne	43.4	34.9	45.0
Lycoming	34.2	39.1	50.1
McKean	53.5	49.3	57.8
Mercer	43.7	47.4	57.2
Mifflin	35.0	27.5	34.8
Monroe	39.1	45.9	47.6
Montour	30.8	43.1	54.5
Northumberland	34.9	38.4	48.8
Perry	36.3	41.4	55.2
Pike	32.6	36.3	55.2
Potter	32.4	36.2	39.9
Schuylkill	32.8	39.7	46.9
Snyder	34.8	37.7	42.1
Somerset	35.6	34.6	35.1

Table 16.--Continued.

Counties	1949-50 Percent	1959-60 Percent	1969-70 Percent
Sullivan	31.6	41.5	33.8
Susquehanna	27.7	29.4	31.7
Tioga	33.1	36.5	38.0
Union	28.1	37.9	42.1
Venango	53.0	57.9	61.3
Warren	41.6	46.6	47.3
Washington	44.0	42.5	52.5
Wayne	23.5	25.3	28.8
Westmoreland	43.6	43.0	50.0
Wyoming	28.2	28.2	40.1
New York	30.8	33.9	37.9
Allegany	35.7	37.4	45.3
Broome	39.5	45.3	43.3
Cattaraugus	33.7	37.5	40.6
Chautauqua	41.6	45.0	44.7
Chemung	43.4	45.9	49.3
Chenango	26.3	31.6	35.2
Cortland	26.0	29.8	32.8
Delaware	19.0	25.3	28.2
Otsego	24.4	26.9	24.8
Schoharie	26.6	27.7	31.4
Schuyler	44.2	46.1	50.2
Steuben	32.6	41.5	44.0
Tioga	36.0	34.7	43.3
Tompkins	37.0	43.9	45.1

Sources: U.S. Censuses of Agriculture, 1950, Counties and State Economic Areas, Middle Atlantic States, pp. 40-44 and 434-438; 1960, New York, pp. 142-145 and 152-157, Pennsylvania, pp. 142-145 and 152-157; U.S. County and City Data Book, 1972, pp. 341, 401, and 413.

because of the extreme significance of supplemental employment to agricultural maintenance and development in the northern Appalachians, some analysis of the topic of off the farm work would add invaluable background to the subsequent analysis of the causes of agricultural depopulation.

The farm population of course is not static; people are continuously leaving the farms for nonfarm residences and some persons from nonfarm and urban locations become associated in various degrees with the agricultural production operations on a farm, or place. There are people, e.g., the rural nonfarm who may engage in agricultural-like activities but who do not produce and/or sell enough in value to qualify their land as a farm. Some of the latter group could be former farm residents who either moved from the farm, or were "declassified" due to changes in the census definition of "minimum" farm. Two other possibilities are that they were long time rural nonfarm residents who carried on "subminimal" agricultural production activities, by census definition, i.e., residents of the open country, villages, and urban areas; or perhaps, they are former urban people who resettled in a rural nonfarm locality. We may assume however that there exists a very small amount of agricultural production that is not counted as "the Census definition of a farm is purposely designed so as to include nearly all agricultural production in the United States" (Hathaway and Waldo, 1964, p. 61). In 1950, the time under investigation here, a place of less than three acres from which an annual production value of at least 150 dollars were sold, defined the smallest possible farm. Any place of three acres or more with an agricultural production, exclusive of home-garden products, whether sold or used at home worth at least 150 dollars determined a farm (Foote, 1970, pp. 18-19).

This researcher suspects that there are more agricultural activities within the Region of an inadequate scale to be officially included within the agricultural census than in the Nation as a whole. This appears to be the case given: the author's observations within the field; the relative availability of land on which to produce agricultural crops, to pasture a single animal or small number of animals, and/or to raise forestry products; and the Census exclusion of small places that do not sell agricultural production. It must be remembered that Pennsylvania has the largest rural nonfarm population in the United States and that many of the rural residents live in the more mountainous portions of the State. Further southwest in the Central Appalachians cultivating a garden is a very characteristic part of the mountain culture, and to a somewhat lesser extent it is within the northern Appalachians. Thus, while the role of off the farm employment is considered--here primarily that of the part-time farmers because of the availability of the data--cognizance should not be lost of the "farming" activities of those who are _not_ by census definition counted as farmers.

Of those persons who could qualify as farm operators, according to the 1950 Agricultural Census, all were operators of farms grouped into two categories: commercial farms and other farms. Other farms included part-time farms and residential farms. Criteria for part-time farming in addition to the operator having worked 100 or more days off the farm in 1949 were sale of farm products of $250 to $1199 and a nonfarm income of the farm family greater than the value of sold agricultural products. Residential farms included nearly all farms of agricultural product sales of less than $250. Like part-time farmers some residential farm operators worked off the farm more than 100 days. Because of changes in the criteria for classifying types of farms, accurate comparisons of the data to earlier censuses was generally prohibitive; nevertheless, residential farms represented some subsistence and marginal farms (U.S. Bureau of the Census, 1950, Agriculture, Vol. 1, pp. xix-xx).

In his analysis of part-time and residential farms of Megalopolis, Higbee (1960) found some characteristics of these types of farming in the early 1950s that may be applicable to many of the more urban-affected areas of the northern Appalachians; and, these general features that he found were pertinent to some of the Region's eastern counties included within the megalopolitan study, i.e., Carbon, Lackawanna, Luzerne, Monroe, Pike, and Schuylkill. Most of the production was for home consumption. Because the farms were smaller than commercial farms, they occupied proportionally less of the total rural area than their relatively large numbers would have suggested. Dairying engaged very few of these farmers; whereas, poultry farming was a major activity. Some of the agricultural products which were the most suited to part-time and residential farming were: vine fruits, poultry, garden crops, and horticultural plants.

The land and building values per acre of these farms were higher than for commercial farms, but much of this may be accounted for by their tendency to be located nearer to the cities, where real estate values were higher. The farms often were located on poorer soils than commercial farms, but near a city the conspicuousness of the part-time and/or the residential farmers was explained by their financial ability to offer more for land than a commercial farmer. There was an inclination for the percentage of these two types of farms to increase with urbanization. "Part-time and residential farms are important for their impact upon the cultural landscape of Megalopolis, but their productivity is of slight significance" (Gottmann, 1964, pp. 310-314).

One of the major difficulties presented to one who is attempting to gain some generalities on the effects of part-time farming on agriculture and the outmigration of farm people is the multi-faceted nature of the part-time farming operations and the diverse social, cultural, and economic characteristics of the persons who use part-time farming as a style of living and/or a livelihood. Examples of the diverse agricultural activities of part-time farmers in a few contiguous counties of the study area were presented above along with some generalizations on the main products of such farming.

Gaining some impression of the range of production of these farms however may be easier than determining who the farm operators and their families are or were. One of the few studies on the diverse characteristics of part-time farmers based its typology ". . . upon past, present, and future commitment to farm and nonfarm occupations." Using career intentions, the study of 153 farmers resulted in 24 types (Fuguitt, 1961, p. 39). Generalizations that are meaningful and possible on such a heterogeneous collection of persons are few. In a study of a subregion in eastern Kentucky, it was found that an approach dividing the part-time group into subgroups would allow for ease of comparison and that a more complete analysis of the total farming in an area would include the rural nonfarm families who in the study had the highest percentage of the sample with farming operations, yet their agricultural activities were too small to be counted by the Census. Additional types of part-time farming families carried on farming characterized as "spare-time," "small-scale," and "large-scale" (Galloway, 1956). The first compared closely to the 1950 census definition of the smallest commercial farm with sales between 250 and 1199 dollars. In addition spare-time farms were those whose families worked off the farm less than 100 days per year and/or have other sources of income that was less than farm income. Summary data was also given in the 1950 agricultural census on all farm operators who worked off their farms in 1949. In general, the census data on both other farms and part-time farms revealed significant decreases in these types of farms between 1950 and 1954 in most of the northern Appalachian counties. Apparently large numbers of these farmers gave up or moved out of most agricultural operations during this period.

As indicated above the residential type of farm according to the 1950 Census of Agriculture was very heterogeneous, including subsistence, marginal, the smallest commercial farms, and farms of off the farm working operators. In 1959 a new dimension of these farms was recognized when they were termed "part-retirement"--one of the criteria being the farm operator was 65 years old or older. This age classifying factor was adhered to and the part-retirement type of farm was primarily substituted in the place of the older residential type of farm through the 1969 Census.

> In previous censuses, the age of the farm operator was not a criterion for grouping farms by economic class. Since the number of elderly people in our population has been steadily increasing during recent years, a separate classification for farms operated on a part-retirement basis was considered important for an adequate analysis of the agricultural structure of a county or State (U.S. Bureau of the Census, 1959, Agriculture, Vol. I, p. xxiv).

Commonly well known among farm people is that many of their numbers prefer to "retire" on their farms and reduce their farming tasks as they grow older. Older farmers have generally less drive, stamina, and energy. They may lose some of their managing abilities and capabilities of keeping informed of the most recent developments in agricultural science. They have probably less economic objectives than the younger farmers with growing families. Thus, all these personal differences associated in varying degrees with age influence the system of farming used on a farm. Average age of the farm operators in New York and Pennsylvania has not changed as much as expected (Table 17).

Table 17.--Average Age of Farm Operators, 1940-1969.

State	1940	1945	1950	1959	1964	1969
New York	52.1	50.9	50.4	50.9	51.2	51.2
Pennsylvania	51.6	50.5	49.9	50.6	50.9	50.5

Sources: U.S. Bureau of the Census, Agricultural Census, 1950 and 1969, Summary Data for New York and Pennsylvania.

As farmers grew somewhat more elderly and sons decided not to go into farming or succeed their fathers in the business, another movement partially filled the gaps in farm management created by the increasing crude death rate for farmers. This was ". . . the increasing dispersion of city people through the countryside" (Hart, 1963, p. 17). Although their management was quite different than that of the former farmer owners, some likewise used the farm as a retirement or semi-retirement residence. Many of these farms undoubtedly stayed within the residential or part-retirement type of farm category as sales were often not sufficient to qualify the farm as a commercial operation. In the heavily urbanized Northeastern United States, many financially-able urban persons purchased farms of various sizes from the descendants of full-time farmers and turned some into country residences. Some of the buildings were renovated. Frequently, the land was permitted to return to woody vegetation. At other times the more productive lands were rented to the local farmers and/or some of the land was used for the keeping of beef cattle and riding horses. A number of these farms have served as pre-retirement residences where owners spend weekends, summer vacations, and hunting seasons. This "resettlement" of urban persons on farms began in the post-World War II era, in the late 1940s and early 1950s (Thompson, 1966, pp. 363-366). Localities of the northern Appalachians situated within commuting distances of the large cities have been especially affected by establishment of the "new residential farms."

Another urban influence upon rural areas has come from the increasing interest of urban people in open space and outdoor recreation. What possibly could be called "recreational farms" have a wide variety of owners and functions: hunting camps, summer camps, various club's properties, union and company rest and recuperation places, associations and institutional lands, and camp grounds (Gottmann, 1964, p. 319). However, few of the owners continued with sufficient agricultural activities to qualify as farmers. This writer found in a post-World War II study of Pennsylvania through the 1950s that camping and seasonal housing were associated with decreases in agricultural acreage, especially for counties near major cities and in traditional recreational-resource regions. For some counties agricultural resource changes, i.e., decreases in farm land, were also related inversely to farmers' income from hunting, fishing, and other recreational activities that gained importance in the 1960s (Slocum, 1969, pp. 84-88). In general the consequences of the establishment of what the Census has termed the "other farms," seem to have been a temporary retaining of some people and lands in agriculture, an eventual decrease in agricultural acreage, and a maintenance of a slight increase in the rural population.

<u>The capital intensive agricultural component in 1949-1950</u>. The second most important component in describing the composition of agriculture in 1949-50 was related to the increased emphasis on applying capital inputs in agriculture. This component explained more than 23 percent of the total variance (Table 14). One variable, the average value of implements and machinery per farm acre, highly correlated with the component with an r of .93 and suggested the overall role of mechanization in determining the value of this

component. Therefore, the intensity of a county's capital investment in agriculture could be quite accurately measured and represented by the value of agricultural tools and machinery per farm acre.

Other agricultural and capital related variables: average value of land and buildings per acre, percent of farms reporting tractors, average expenditures for fertilizer per farm reporting, and average dollars spent for gasoline per farm had moderate and positive correlations with the capitalization component. Therefore, a high probability exists that the interpretation of this component as capital invested in agriculture or capital intensive agriculture is the correct identification.

The moderately high negative associations between each of two variables and the capital component gave further clues to the composition of the component and the effects of capital input use on changes in agricultural systems, especially the land use aspects. The farming areas with much capital investment in their agricultural operations tended to have lower pasture-cropland ratios, $r = -.75$, and as more capital was invested on farms, the relative amount of pasture compared to cropland declined significantly (Table 14). The capital inputs and new technology could be applied to cropland much more successfully than to pasture. Consequently, the pasture land acreages went out of farming more rapidly than the cropland did although the numbers of cattle and calves remained about the same or increased slightly. The percent of the cropland which had hay harvested from it was associated inversely with the component, $r = -.73$, meaning in part that farming areas or counties with more emphasis on the harvesting of hay from cropland had lower levels of invested capital in the agricultural operations than did those using relatively more of the cropland for other crops. Some of the above relationship probably could be accounted for by the generally earlier modernization and mechanization of the harvesting operations for grains than for hay.

With the arrival of many more machines on the farms, e.g., tractors to which many kinds of equipment could be hitched, the quantity of plowing, planting, cultivating, and harvesting that a farmer was willing and capable of doing successfully in a season increased significantly. Subsequently, a more intensive agriculture was feasible, causing a massive abandonment of permanent pasture lands. Relatively cheap off farm inputs, e.g., tractors and the gasoline for the fuel, fertilizer, and new plant varieties, increased fodder yields on the arable lands, making the use of many permanent pastures unnecessary. In the cattle raising and dairy areas much less reliance was put upon the permanent pastures also when the semi-surplus, reserved, and arable pastures were either improved or turned into hay fields. The hay lands were plowed up more than in the past following the departure of the draft horse technology.

In addition as more had to be grown from each farm acre adaptable to the new off the farm capital inputs to pay for these newly purchased resources, total production and yields per acre were forced to increase on the cropland and/or the crops and agricultural products raised or produced had to be more economically and nutritionally valuable than the traditional agricultural commodities. A moderate tendency for the value of production to increase with expanded use of capital inputs was supported by the study's finding that land productivity, agricultural sales per acre, correlated ($r = .60$) with the capital component.

To give an illustration of land use intensification processes at work throughout the Northeast, one may cite data on selected forage, grains, and hay production which reveal the downward trends of the latter, and the very large increases in the production of corn silage and grain (Table 18). Oats, wheat, barley, rye, and other small grains cut for hay have increased, also. Cattlemen and dairy farmers were strongly motivated to expand production through increasing the quality of forage, e.g., by expanding corn and grass silage production, and reducing their feed grain purchases. Both oat acreage and oat production for grain decreased primarily because of the displacement of the work horses by the tractor; however, some of the decline in oats as a popular crop may have been caused by the partial breakdown in the traditional rotation system in which oats served as the nurse crop for the reseeded grasses planted the year following a corn crop. Changes in corn production had an important effect on the nature of cropland use.

In summary, a greater proportion than formerly of the total cropland was occupied by high yielding forage and grain crops. Like in much of American agriculture and various farming areas, the changes led toward monocultural types of farming. Farm lands not possessing the physical characteristics, i.e., arable soil, good drainage, relatively level topography, and efficient field size, favored by the

Table 18.--Hay and Corn Silage and Grain Production Trends in the Northeast, 1949-1969.

	1949	1954	1959	1964	1969
			All Hay Production (tons)		
New England	2,681,432	2,823,619	2,588,304	2,101,290	1,758,024
Maine	619,969	601,128	563,121	457,226	333,701
New Hampshire	301,556	296,426	253,249	189,513	161,584
Vermont	977,639	1,107,405	1,042,246	952,781	836,785
Massachusetts	398,522	408,982	365,857	254,703	228,343
Rhode Island	34,664	38,224	37,326	24,820	17,300
Connecticut	349,082	371,454	326,505	222,247	180,311
Middle Atlantic	7,839,951	9,400,159	9,903,867	8,843,353	8,251,406
New York	4,402,336	5,491,755	5,390,738	5,017,377	4,648,116
New Jersey	390,415	427,378	430,569	317,099	278,506
Pennsylvania	3,047,200	3,481,026	4,082,560	3,505,392	3,324,784
			Corn Cut for Silage (tons)		
New England	1,218,342	1,169,804	1,289,614	1,309,211	(2,754,534)
Maine	91,533	77,567	95,116	135,322	(312,223)
New Hampshire	91,532	91,360	109,205	128,516	(244,452)
Vermont	513,088	461,372	459,982	516,256	(934,269)
Massachusetts	218,472	206,732	243,233	276,469	(459,373)
Rhode Island	42,350	32,120	40,760	48,875	(50,825)
Connecticut	261,367	300,653	341,318	480,242	(753,392)
Middle Atlantic	6,527,807	6,602,664	6,790,533	8,396,208	(11,045,333)
New York	4,015,979	3,849,779	4,001,716	4,418,233	(6,154,336)
New Jersey	407,129	435,415	404,691	459,593	(473,317)
Pennsylvania	2,104,699	2,317,470	2,384,126	3,518,382	(4,417,680)

Table 18.--Continued.

	1949	1954	1959	1964	1969
Corn Harvested for Grain (bushels) on All Farms					
New England	703,033	452,759	385,554	283,416	665,194
Maine	53,716	17,150	9,388	11,265	102,557
New Hampshire	66,186	25,110	15,649	14,957	47,334
Vermont	102,038	52,564	52,752	53,937	232,226
Massachusetts	214,271	158,201	140,610	94,690	168,547
Rhode Island	35,803	19,097	16,618	21,620	23,163
Connecticut	231,019	180,637	150,527	86,947	91,367
Middle Atlantic	61,805,401	66,994,913	72,108,456	65,587,214	97,883,897
New York	7,703,216	11,262,597	12,255,959	11,885,131	21,414,650
New Jersey	4,592,239	6,407,406	6,297,835	3,246,007	5,068,801
Pennsylvania	49,509,946	49,324,910	53,554,662	50,456,076	71,400,446

Sources: Various Censuses of Agriculture, General Reports, Statistics by Subject, 1949 to 1969.

[a]Corn cut for silage data in 1969 represents green weight.

new inputs, including mechanization, were often abandoned. With the presence of inexpensive energy the large increases in yields per acre, e.g., for corn and alfalfa, farming activities could be carried out profitably using fewer acres. Agriculture in general became much more intensive in the Region.

Although there was a general movement toward capital-intensive agriculture affecting most agricultural systems within the northern Appalachians during the late 1940s and 1950s, certain areas and types of farming were especially characterized by the capital component as reflected in the areal patterns of the component scores (Figure 23). The highest positive scores coincided with areas with more grain and specialty crop production than for the study area as a whole. The counties with considerable capital inputs clustered together in east-central Pennsylvania, and within Allegheny County and north and northwest of Pittsburgh. Several urban dominated counties, including Erie, Luzerne, Blair, and Schuylkill in Pennsylvania scored high on the use of capital inputs presumably because of the presence of vegetable and other intensive agriculture. Two counties, Centre and Tompkins, within which are located Land Grant universities, The Pennsylvania State University and Cornell University, respectively, had high measures for the capital component which could mean that the capital oriented agriculture advocated by these institutions particularly influenced the nature of agriculture on the nearby farms. Moderate and negative component scores were found for most of the dairy counties of New York; yet, Tompkins County was very much the deviant county with a relatively high capital input quantity, suggesting perhaps, that the

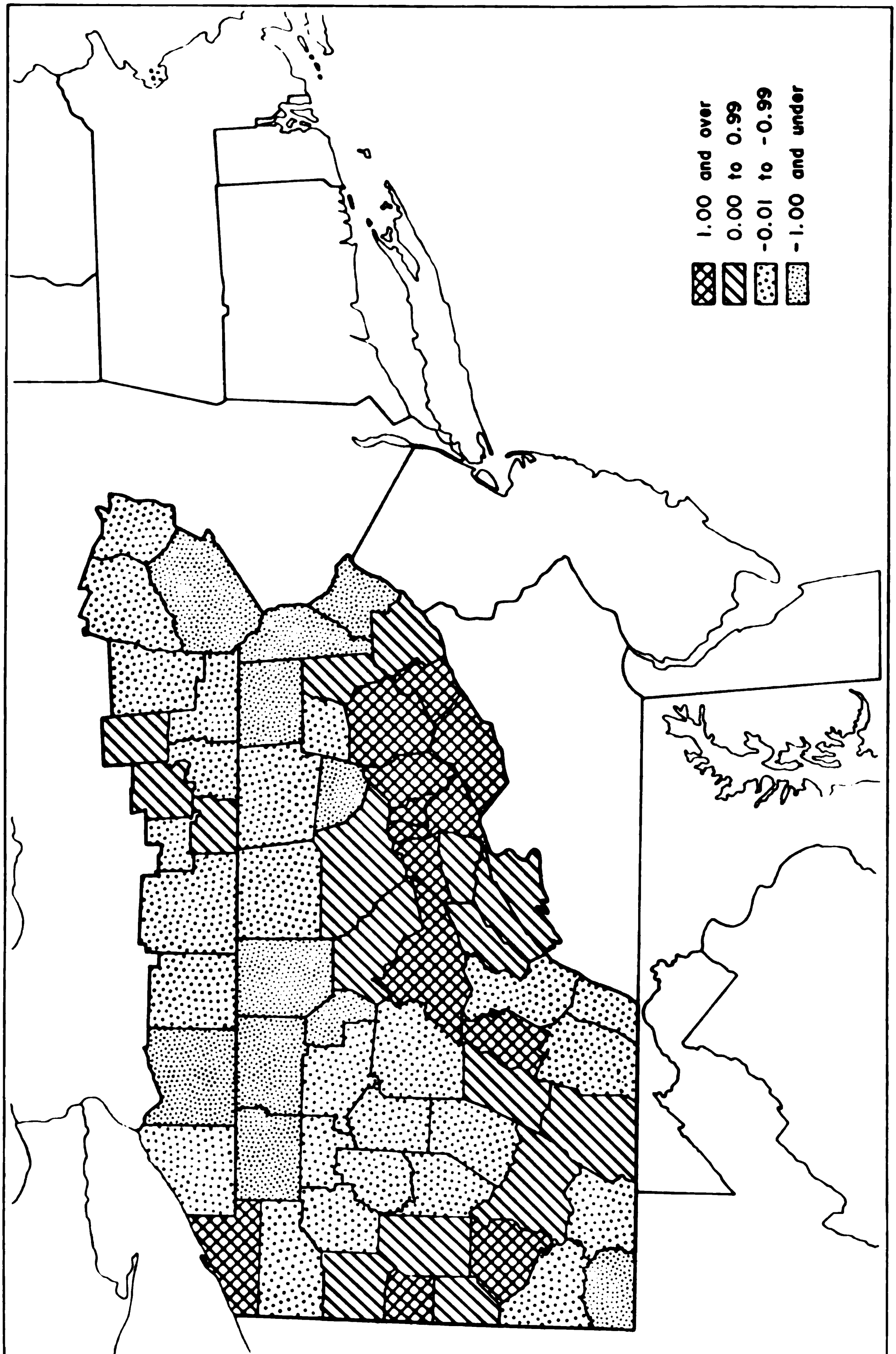

Fig. 23.--Areal Distribution of Component Two Scores, Capital Intensive Agriculture, 1949-1950.

capital orientation in dairying had only recently begun. The dairying counties of northeastern Pennsylvania had the lowest capital resource use values; thus, the capital input emphasis in this primary dairy area had perhaps hardly started, and was much less evident than in the neighboring New York counties. As larger percentages of cropland with hay harvested were found to be uncharacteristic of farms with high capital use but characteristic of dairying, some explanation is given for lower relative amounts of capital inputs in dairy production. Green County, Pennsylvania because of a sheep specialization, a type of farming with a low potential for mechanization, had the lowest negative score. The overall and comparative lower reliance on capital resources in the predominantly general livestock and dairy counties indicated that animal husbandry in general took longer to be mechanized than crop farming and the presence of animals producing manure greatly reduced the need to purchase fertilizer.

The labor oriented agricultural component in 1949-1950. The third component selected for 1949-50 explained more than 15 percent of the total variance. Because several variables were associated moderately and similarly with this component, the identity of the component could only be partially determined. The two most important correlations were with percent farms reporting trucks and the value of hired labor per farm reporting (Table 14). What kind of farming do these variables suggest? The pattern of positive component scores exhibited three main groups, each with its own social, economic, and agricultural properties; thus, whatever major agricultural characteristic the component embodied, it was not restricted to one type of agriculture in 1949-50 (Figure 24).

The two groups of counties with the highest scores were major urbanized counties, e.g., Allegheny, Lackawanna, and Luzerne and the nearby counties significantly affected by urban influences, i.e., recreational demands and fresh-produce needs. The urban counties had the main areas of vegetable, fruit, and horticultural production within the Region. Such specialized-crop activities require hired labor to a greater extent than most types of farming and trucks commonly are used in the harvesting and marketing operations. Hired labor on a part-time basis would be more readily available in the urban counties. A number of counties in the eastern portion of the Region, e.g., Wayne, Wyoming, Pike, and Delaware supplied recreational opportunities for both the local cities and the New York or Philadelphia metropolitan areas. The influx of seasonal residents into these counties undoubtedly generated extra incentives for local production of small crops which required extra labor for short periods during the summer months. Included with this latter group of counties are the dairy counties in the eastern part of the Region. Dairying, as revealed in this study, has had a high association with labor productivity; and thus, especially during the heavy work periods, e.g., the spring flow of milk and the spring planting of crops, seasonal hired help was employed. In addition many dairy farmers owned trucks to transport milk to the creameries prior to the appearance of bulk tanks. A number of these counties had dairymen who as producer-distributors retailed their milk and had need for trucks on their milk routes (Metzger and Pierce, 1951).

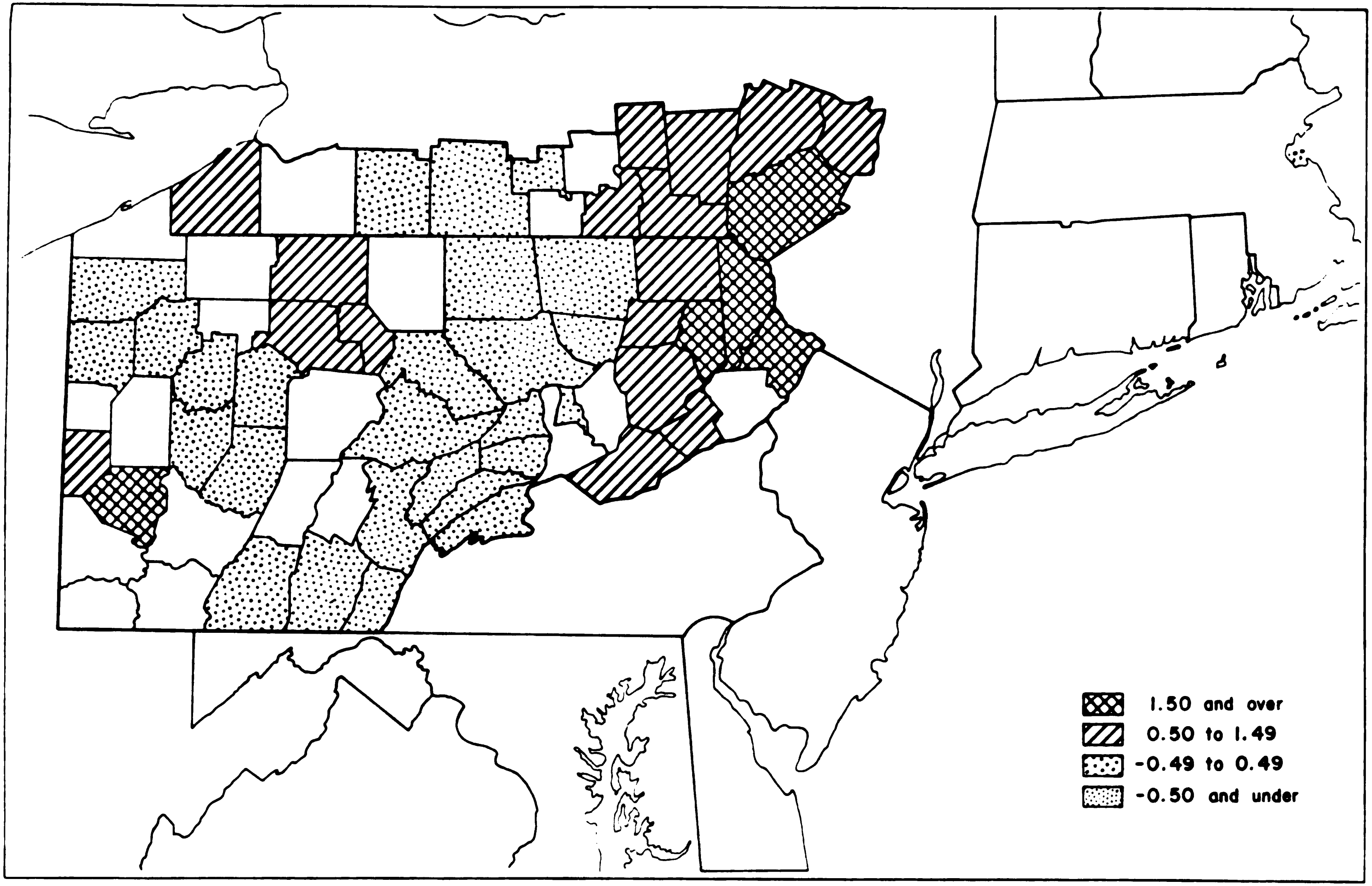

Fig. 24.--Areal Distribution of Component Three Scores, Labor Oriented Agriculture, 1949-1950.

The third group of counties were located in the western part of Pennsylvania and were marked by their relative isolation. Here the need for the transportation aspect of the component was most important, but the presence of one of the Region's most forested and wilderness-like landscapes, brought recreational influences, resulting in effects on agriculture, perhaps similar to those cited for the eastern areas of the northern Appalachians.

A few scattered counties also had positive component scores. Erie and Chautauqua counties abutting upon Lake Erie had vegetable and fruit emphasis, especially Concord grapes (Dahlberg, 1961). This agricultural activity requires seasonal workers. Carbon and Schuylkill counties with some specialty-crop farming also, associated with the urban markets of the southern and central anthracite fields, would have had need for hired labor during certain times of the year.

The additional variables, with slightly less correlation with the component than the truck and hired labor variables, supports the interpretation of the component as farming types with a special need for extra labor and transportation inputs for harvesting and marketing purposes (Table 14). Hay acreage of course suggests dairying. Land productivity is related to capital intensive agriculture and particularly to truck and specialty-crop farming. Feed or grain purchases are characteristic of dairying.

The two additional components in 1949-1950. The remaining components of agriculture in the northern Appalachians in the 1949-50 period individually accounted for a very small proportion of the total variance; and thus, were not considered significant to the extent that they required discussion here (Table 14). However, from the very few variables correlating with these components and the areal patterns of the component scores, it was hypothesized that component four represented possibly residential farming and component five fitted extensive farming characteristics. Residential farming appeared to be located near urban places and also in the more rural and isolated counties--especially those with high off the farm work. The counties with strong extensive farming scores were usually the most isolated and physically poor.

CHAPTER 7

ANALYSIS OF THE COMPONENTS OF AGRICULTURE: THE DOMINANT CHARACTERISTICS AND SYSTEMS OF FARMING IN THE NORTHERN APPALACHIANS, 1969-1970

Identification of the Region's Agricultural Components

The major purpose of this chapter, like the chapters immediately before, is to establish an overall view of agriculture within the Region during a given time. Once the major dimensions of agriculture in general are determined, the importance of each selected component to certain subareas and types of farming is evaluated.

The Components of Agricultural Systems in 1969-1970

Six components were found by the principal component analysis in the agricultural data, but only three were important in explaining a large proportion of the total variance found within the agricultural data matrix (Table 19). The six components however accounted for more than 85 percent of the agricultural data's total variance. The first and most important three components, the topics of most of the description and discussion which follows, together explained more than 66 percent of the total variation. In each successive time period analyzed in this study it was found that for each more recent time,

Table 19.--Major Loadings from the Principal Components Analysis of Agriculture, 1969-1970.

Positive Loadings Variable	Loading	Negative Loadings Variable	Loading
Component One: Dairying and Off-Farm Work Dichotomy Ratio			
Avg. cropland acreage	.86	% farm operators working 100 days off the farm	-.84
% of farms, dairy	.85	Ratio of farm expenditures to value of agricultural production	-.61
Avg. $ spent for gas	.82		
Avg. size of farm in acres	.75		
Avg. expenditures for feed	.69		
Avg. expenditures for fertilizer	.54		
Explained Variance	28.39%		
Component Two: Capital Intensive Agriculture			
Avg. value of implements and machinery	.84	% harvested cropland, hay	-.73
Land productivity	.81	Pastureland-cropland ratio	-.60
Farm persons per 100 acres	.74	Avg. size farm in acres	-.56
% cropland harvested	.73		
Avg. value of land and buildings	.73		
Avg. expanditures for fertilizer	.57		
Value of hired labor	.50		
Explained Variance	25.44%		
Component Three: Labor Oriented Agriculture			
Labor productivity	.73		
Value of hired labor	.58		
Pastureland-cropland ratio	.52		
Ratio farm expenditures to value of agricultural production	.51		
Explained Variance	12.15%		

Table 19.--Continued.

Positive Loadings		Negative Loadings	
Variable	Loading	Variable	Loading
Component Four: Residential Farming			
% farms reporting trucks	.64		
Explained Variance	8.23%		
Component Five: Corn Belt Agriculture			
Corn yields	.64		
Value of hired labor	.43		
Labor productivity	.43		
Explained Variance	6.04%		
Component Six: Mechanization and Motorization			
% farms reporting tractors	.68		
% farms reporting trucks	.34		
% farms reporting autos	.23		
Explained Variance	5.21%		

the principal component analysis program uncovered more components, possibly indicating agriculture within the northern Appalachians became progressively more heterogeneous. The increase in the basic dimensions of agriculture can be partially explained by the growing specialization of farms. As a result, general farms, representing an agriculture more motivated by a style of living, declined and specialized types of production, e.g., poultry, resembling more of a business or perhaps a secondary industry, expanded.

The increasing specialization of farm operations required more and more capital investment and off the farm inputs as the more "narrowed" scope of agricultural production per farm antiquated many of the resources found on the farm. One of these "indigenous resources" was the farm population and labor, but not the only one. A future United States Secretary of Agriculture overgeneralized but correctly identified the on-the-farm resource, the use of which was diminishing at the most rapid rate, when he stated, "American agriculture is an expanding industry in every important respect except one--the number of people required to run our farms" (Butz, 1960, p. 381). Although it is true that many of the elements that make up the so-called agribusiness--a concept that interrelates farming with the businesses of manufacturing, the supplying of agricultural inputs, and the marketing of agricultural products (Davis, 1956)--have had to be greatly expanded to meet the demands for more agricultural production, there have been several on the farm resources which have significantly declined as important inputs for farming as the use of capital rose.

A few examples pertaining to agriculture will suffice to illustrate the common tendency to stress growth and neglect the analysis of the consequences and costs of growth. In an analysis of change, of critical importance, if the findings and interpretations are to play a successful role in solving problems, is the objective to be realistic--to be so requires a serious effort to measure the debits as well as the assets. In addition to the highly significant decline in number of farm persons, another major factor of production in agriculture, land in farms decreased (Table 20). On the farm power units, particularly horses, almost totally disappeared. The new technology dictated the purchase of more inputs not present on the farm, requiring ever larger capital investments, most of which in the past was financed by cash farm receipts, but since World War II farmers have had to increasingly resort to the use of credit for expansion of capital investment, a development that greatly raised farm debt (Garlock, 1960, pp. 375-378) (Table 21). Many farmers trapped on an escalator that they could not leave easily have found profits per unit of production when rates of return to capital, management, and labor are considered very marginal indeed.

The principal component in 1969-1970. The major component of agriculture in the northern Appalachians at the end of the 1960s decade was the same as at the end of the 1940 decade. The dairy farming and off-farm work dichotomy ratio explained more than 28 percent (3 percent less than in 1949-50) of the total variation in the agriculture of the Region (Table 19). A comparison of the variables associated with this component in about 1950 and 1970 reveals a

Table 20.--Land in Farms for the United States, Censuses of 1850 to 1969.

Year	Number of Farms[a]	Total Acres[a]	Percentage Acreage Change from Previous Census[b]
1850	1,449,073	293,560,614	c
1860	2,044,077	407,212,538	38.7
1870	2,659,985	407,735,041	0.1
1880	4,008,907	536,081,835	31.5
1890	4,564,641	623,218,619	16.3
1900	5,739,657	841,201,546	34.6
1910	6,366,044	881,431,469	4.8
1920	6,453,991	958,676,612	8.8
1925	6,371,640	924,319,352	-3.3
1930	6,295,103	990,111,984	6.8
1935	6,812,350	1,054,515,111	6.9
1940	6,102,417	1,065,113,774	0.6
1945	5,859,169	1,141,615,364	7.6
1950	5,388,437	1,161,419,720	1.5
1954	4,782,416	1,158,191,511	d
1959	3,710,503	1,123,507,574	-3.3
1964	3,157,857	1,110,187,000	-1.2
1969			

Source: United States Census of Agriculture: 1964 and 1969.

[a]The data represent the nonconterminous United States for 1900, 1910, 1930, 1940, 1950, and 1959.

[b]Except for 1964 all data represent the conterminous United States.

[c]Not available.

[d]Less than 0.05 percent.

Table 21.--Assets and Farm Debt in the United States, 1950-1972.

Year	Assets	Liabilities	Total Farm Mortgage Debt
	Billion Dollars	Billion Dollars	Billion Dollars
1950	132.5	12.4	5.6
1951	151.5	13.1	
1952	167.0	14.7	
1953	164.3	16.1	
1954	161.2	16.9	
1955	165.1	17.6	8.2
1956	169.6	18.8	
1957	177.9	19.3	
1958	185.8	20.4	
1959	202.1	23.6	
1960	203.5	24.8	12.1
1961	204.2	26.2	12.8
1962	212.8	28.7	13.9
1963	221.4	31.7	15.2
1964	229.2	34.9	16.8
1965	237.2	37.6	18.9
1966	253.7	41.6	21.2
1967	266.6	45.7	23.3
1968	279.9	50.4	25.5
1969	294.0	54.6	27.1
1970	304.7	58.1	28.4
1971	316.2	61.1	29.5
1972	341.1	66.9	31.4

Source: U.S.D.A. Handbook of Agricultural Charts, 1973, p. 19; Economic Tables, E R S-559, p. 27.

strengthening of the relationships of the following variables at the latter time: average cropland acreage; percent farms, dairy; average dollars spent for gas; average size of farms in acres; and average expenditures for fertilizer. Two of the associations of variables with the component that declined in importance were with percent farm operators working 100 days off the farm and average expenditures for feed.

What is the general meaning of the changes over time in the associations of the variables loading on this component? The component was slightly more affected by dairying in 1970 than in 1950. Over the Region as a whole there were relatively fewer off the farm working operators in 1970 than in 1950 probably because many of those farmers had either gone on to full-time employment in their nonfarm work or had retired from farming. In contrast relatively fewer dairy farmers than farm operators working off the farm gave up farming in 1970 than in 1950. As dairying increased in importance compared to off farm work for farmers, the additional emphasis on the use of gasoline, fertilizer, and cropland plus the increase in farm size was to be expected. Some of the extra association of gasoline and fertilizer use however was due to the growing average use of each of these purchased inputs in the major dairy counties (Table 22). The increasing positive importance of average cropland to dairy farms can be partly explained by the rising use of several off the farm inputs, e.g., gasoline and commercial fertilizers, which can be more profitably used on cropland and by the expanding average size of dairy farms. The variable, average expanditures for feed, was associated

Table 22.--Average Expenditures for Gasoline-Petroleum Products and Fertilizer Per Farm in Major Dairy Counties,* 1954 and 1969.

	Expenditures for Gasoline-Petroleum Products per Farm 1954	Expenditures for Gasoline-Petroleum Products per Farm 1969	Expenditures for Commercial Fertilizer per Farm 1954	Expenditures for Commercial Fertilizer per Farm 1969
Pennsylvania	$ 314	$ 553	$ 334	$ 809
Bradford County	344	541	231	703
Centre County	424	714	430	1054
Crawford County	269	432	211	666
Juniata County	324	532	273	610
Lackawanna County	303	589	258	647
Lycoming County	327	572	348	766
Mifflin County	281	586	298	793
Potter County	339	573	454	993
Somerset County	333	582	347	867
Sullivan County	255	481	173	759
Susquehanna County	324	573	174	562
Tioga County	347	539	213	559
Union County	334	662	393	978
Wayne County	266	558	153	566
Wyoming County	306	588	239	798
New York	372	705	416	950
Allegany County	289	494	267	585
Broome County	300	491	224	522
Cattaraugus County	302	516	206	508
Chenango County	336	599	224	618

Table 22.--Continued.

	Expenditures for Gasoline-Petroleum Products per Farm 1954	Expenditures for Gasoline-Petroleum Products per Farm 1969	Expenditures for Commercial Fertilizer per Farm 1954	Expenditures for Commercial Fertilizer per Farm 1969
Cortland County	470	710	348	771
Delaware County	283	565	169	646
Otsego County	354	607	269	666
Schoharie County	397	654	284	702
Steuben County	341	668	569	1028
Tioga County	326	580	322	767
Tompkins County	388	641	455	997

Source: Data calculated from U.S. Censuses of Agriculture, 1954, 1959 and 1969.

*A dairy county is defined if 40 percent or more of the farms in a county were of the dairy type in 1964 as defined by the U.S. Census of Agriculture, 1964.

less with the component in 1970 than 1950, probably because other purchased inputs became relatively more important.

There were only minor changes in the patterns of component scores (Figures 21 and 25). If the principal component is correctly viewed as the relative importance of dairying compared to off farm employment of farm operators, then the following could be observed for 1969-70. In most of western Pennsylvania, off farm employment of farmers continued to dominate although there was some strengthening of dairying in northwestern Pennsylvania. Dairying's position compared to off farm work for farmers however weakened in some east central counties of Pennsylvania from its status in 1949-50. Dairying gained in importance in the mountainous counties of the extreme southeastern corner of the Region. The basic pattern of emphasis on dairying in the northern portion of the Region remained with few changes.

Over the last two decades there occurred in the northern Appalachians an extraordinary increase in the relative numbers, but a significant decrease in the absolute numbers of farmers working off the farm, i.e., part-time farmers (Table 16). Between 1950 and 1970 nearly all the counties experienced an increase in the percentage of farmers who worked part-time. Without doubt some dairy farmers turned to part-time farming as the health regulations demanded more modern equipment and as bulk tanks became almost a necessity when most can-milk receiving stations (creameries) closed; however, it is likely that many of these dairymen, unwilling or unable to make the adjustments, quit dairying and farming altogether. As indicated previously,

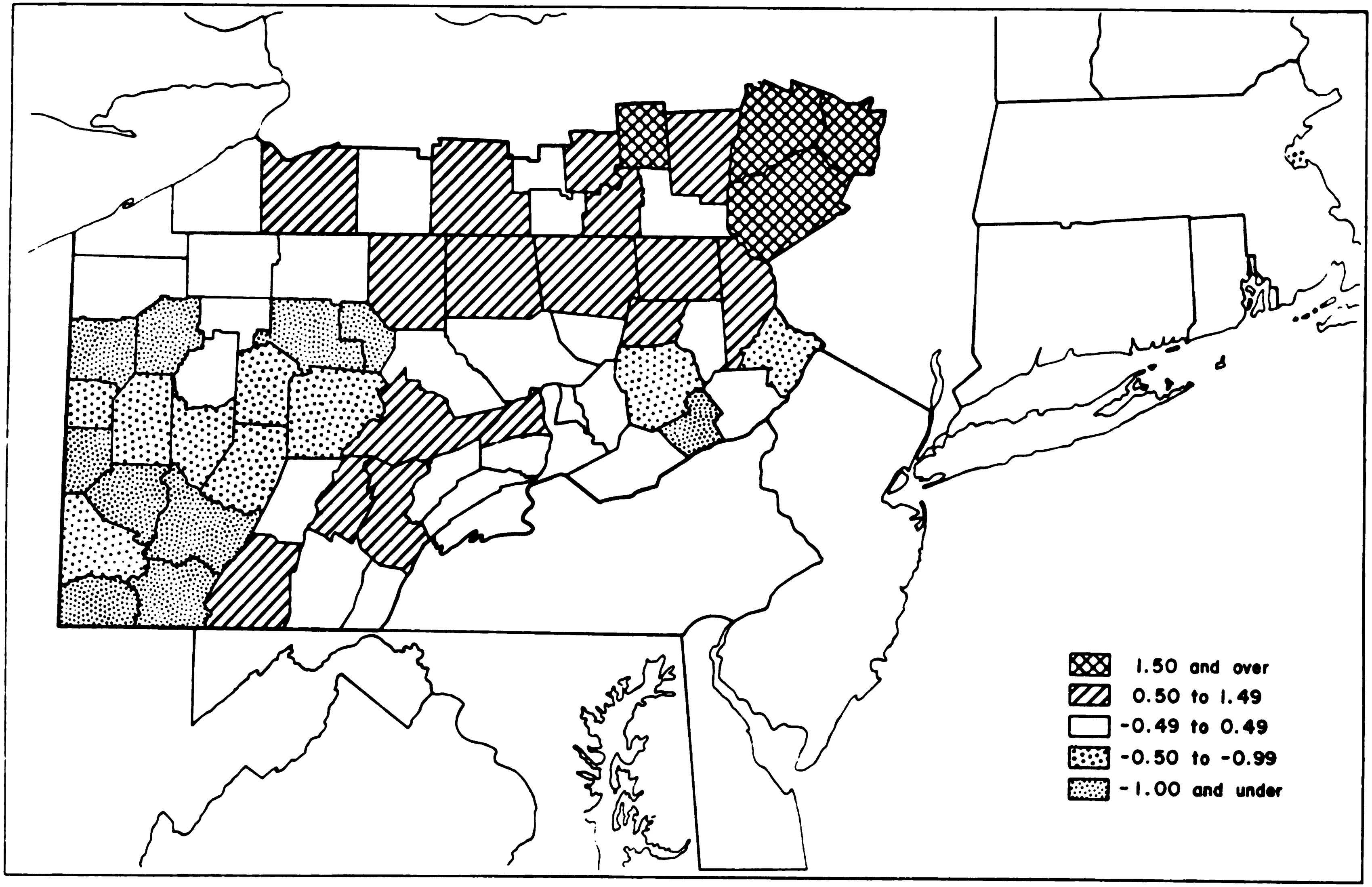

Fig. 25.--Areal Distribution of Component One Scores, Dairying and Off Farm Work Ratio, 1969-1970.

dairy farming and off the farm employment are seldom compatible. With inadequate returns for his labor, capital investment, and management, a dairy farmer--much more restricted by the nature of his farming than most other farmers--has limited alternatives to raising additional income from which he can gain capital; and, unless he is given special considerations for gaining access to credit, he may be forced out of farming more abruptly than will most other farmers. As "much of the land in the Northeast is well suited for milk production but is rather limited in alternative agricultural production because of natural or socially produced restrictions" (Lasley and Shaw, 1970, p. 5), the likelihood is low that a dairyman will shift to other types of farming.

National trends in dairy farming and the effects. More specialization in dairying will make the dairy farmer even more vulnerable to low prices for milk than he was when he ran a diversified farm with a dairying emphasis because of higher fixed costs. Because of these relationships there is generally a growing probability that an impending downward economic change would bring about a sudden and significant decrease in the number of dairy farmers and create a shortage of milk as production dropped. National developments in dairying suggest that this has partly happened and is continuing. Although prices paid to the farmer for milk have risen substantially since the mid-60s production is below that of ten to twenty years ago. The consequences are especially foreboding for the northern Appalachians where a large proportion of farmers are dairymen.

Nationally, there occurred over the last two decades, a significant abatement in various aspects of dairy farming (Table 23). From the early 1950s to 1970 the number of farms with milk cows declined by about eight percent a year. Between 1944 and 1970 cow numbers fell in every year except 1953 (Mathis, 1970, pp. 30-31). Beginning in 1965 total milk production suddenly declined and continued the downward trend until 1970 when a small increase was recorded. Although milk production per cow (production efficiency) continuously increased, this factor was obviously not sufficient to keep total production from declining in the last half of the 1960s. Certainly the large decreases in the number of dairy farms and farmers finally began affecting adversely total production. A regression analysis using these variables would give an indication of the magnitude of relationship but is beyond the scope of this research.

Although the per capita consumption of milk in all products declined from 1942 to 1969, the total use of milk products in the late 1960s remained relatively stable and increased slightly in the first third of the 1970s; this situation, of course, can be largely explained by the increase in population. Note should be made that domestic production of milk has declined to a level below total use (Table 24). Also, apparent for the last ten years are imports of the magnitude of three to four times those of the previous decade which have had to be entered into the scene to maintain a safe margin; yet, for the last ten years commercial stocks gradually declined while at the start of the mid-1970s, government stocks reached a low ebb. At the beginning

Table 23.--Status of Dairying in the United States, 1958 to 1972.

	Milk Cows on Farms[a]	Milk Production Per Cow	Milk Production
	Million	Pounds	Billion Pounds
1958	18.7	6,585	123.2
1959	17.9	6,815	122.0
1960	17.5	7,029	123.1
1961	17.2	7,290	125.7
1962	16.8	7,496	126.3
1963	16.3	7,700	125.2
1964	15.7	8,099	127.0
1965	15.0	8,305	124.2
1966	14.1	8,522	119.9
1967	13.4	8,851	118.7
1968	12.8	9,135	117.2
1969	12.3	9,434	116.1
1970	12.0	9,747	117.0
1971	11.8	10,009	118.5
1972	11.7	10,271	120.3

Source: U.S.D.A., Handbook of Agricultural Charts, 1973, p. 80.

[a]Average number on farms during year, excluding heifers not yet fresh.

Computed from data published in Milk Production, Disposition, and Income (SRS).

Table 24.--Milk Supply, Use, and Carryover, 1950s to 1970s.

Year	Supply			Use	Stocks, December 31	
	Production	Imports	Total	Total	Commercial	Government
	Billion Pounds					
1955	122.9	0.5	137.1	128.2	3.6	5.5
1956	124.9	.5	134.5	128.8	3.6	2.0
1957	124.6	.7	130.9	124.4	3.7	2.8
1958	123.2	.5	130.2	125.5	3.8	1.0
1959	122.0	.6	127.4	123.3	3.7	.4
1960	123.1	.6	127.8	122.4	4.2	1.2
1961	125.7	.8	131.9	121.9	5.0	4.9
1962	126.3	.8	137.0	124.8	4.3	7.8
1963	125.2	.9	138.2	128.6	4.1	5.6
1964	127.0	.8	137.5	132.3	4.3	1.0
1965	124.2	.9	130.4	126.0	3.9	.5
1966	119.9	2.8	127.1	122.3	4.8	a
1967	118.7	2.9	126.4	118.2	4.3	4.0
1968	117.2	1.8	127.3	120.6	4.0	2.7
1969	116.1	1.6	124.4	119.0	3.8	1.4
1970	117.0	1.9	124.1	118.3	3.7	2.1
1971	118.5	1.3	125.6	120.5	3.6	1.5
1972	120.3	1.7	127.1	121.5	3.5	2.0
1973	117.0	2.4	124.9	120.9	3.3	.8

Source: U.S.D.A., Handbook of Agricultural Charts, 1973, p. 81.

[a]Less than 50 million pounds.

of the 1970s, a report projected that the "dairy surplus would fade" and that is what appears to be happening (Mathis, 1970; U.S. Department of Agriculture, 1973, p. 81). An important question asked with the welfare of the Nation's population in mind--is the margin between domestic production and consumption which has decreased, a safe one? Furthermore, should not more concern be given to a higher level of dairy production, given that it is reputed to be "nature's most perfect food," containing important amounts of calcium, phosphorous, and protein--food elements greatly needed by the nearly two-thirds and more than 2.5 billion of humanity who are ". . . undernourished, malnourished, or in other ways deficiently fed and generally poor . . ." (Borgstrom, 1973, pp. 234-235; Borgstrom, 1969, p. xi).

There has been too much attention paid to the rise in milk production per dairy animal and to the goal of more productivity per dairy worker, both of which have not maintained total milk production and have resulted in the loss of many dairy farms and the displacement of thousands of dairy farmers. Curiously, little has been apparently written or said about the decline in total milk production and less in the form of explanations by the advocates of "the new dairying" many of whom do not acknowledge a decrease in milk production.

There are social and environmental costs accompanying the changes that have only infrequently been addressed. Unfortunately, the farmer has paid more than his share of these adjustment costs. "Sacrifice, either in the short run or the long run, is often the reward of those who must leave farming (Heady et al., 1972, p. 223). In a nation and world of rising unemployment, poverty, energy and resource shortages, and hunger, the test of "economic efficiency" can no longer be the sole criteria for judging the success of an endeavor, a policy, or a program. Millions of acres of former dairy farms have been idled and/or abandoned because of the modern techniques of dairy farming. Dairymen continue to abandon their pastures and the soil conserving rotations on their cropland. An extended discussion of some of the new cropping strategies and their implications is presented under "corn Belt agriculture" later in this chapter. The concept of farm, i.e., general farm, in a whole sense is breaking up, and so is the ecological system of farming.

Regional grain demands. Why has this area's agriculture for so long demanded large sums of purchased grains? Dairying is a very significant part of the agriculture of the northern Appalachians and it requires proportionately larger feed grain inputs than most types of farming. At the beginning of this century nearby large and growing urban areas were putting increasing demands on dairymen for fluid milk. For years the location of dairying was restricted to areas close to the market because of the perishability of milk and its relative low value compared to its bulk as basically milk is mostly water. Interestingly, these basic principles for the location of milk production have had applicability up to recent times. Thus, for example, in the 1960s could be written, "only under crisis conditions has liquid milk been imported into Great Britain" although that nation relies heavily upon food imports (Chisholm, 1962, pp. 97-99).

With a large part of the northern Appalachians being in the "shadow" of two of the Nation's largest and most rapidly growing metropolises, New York and Philadelphia, and having a number of cities sited within, extraordinary opportunity existed for the production of fresh milk. Yet, many agricultural entrepreneurs were frustrated by some scarcity of resources. A large part of the land was covered with forest on land too poor, wet, and rough to be pasture. Much of the existing pasture was on hillsides, cleared of their woodlands several decades previously and eroded in the interim. Urbanization had taken some of the best agricultural lands. Considerable effort and care was required to develop more cropland. Some of the woodlands became pastured woodland, but contributed little to the forage needs. Because of relatively short growing seasons, pasturing could supply fodder and nutrients to cattle for less than half of the year; besides, the quantity and quality of the grasses often deteriorated as summer progressed with higher temperatures and lower rainfall. The long winter required the harvest and storage of large quantities of forage, especially hay that was often of fair to poor quality because with traditional haymaking equipment plus hand labor the operations of cutting, raking, drying, gathering, and storing the hay were understandably slow and time consuming; thus, very little of the hay could be harvested during the short period when it contained the highest amount of total digestable nutrients (TDN). Hay yields per acre were frequently low as much hay ripened and deteriorated badly before it could be harvested; consequently, in order to "guarantee" sufficient quantities of hay and other crops for the long and harsh winter, especially in the northern half of the Region, when the cattle had to be housed and given all their nourishment from stored supplies, a comparatively large proportion of a farm had to be set aside as cropland. Some additional cropland had to be reserved as a margin for the low production of the dry years. With the necessity of restricting the livestock from the hayland during most of the growing season--except in the fall cattle grazed on the "afterfeed"--the slowness of the hay harvesting, the subsequent deterioration of much of the crop, and the low productivity of the cropland, most of the best land, i.e., the meadows or cropland which had been designated as such because of superior physical qualities, was restricted to forage production. The space for raising of grains for livestock was very limited indeed.

In the early 1800s New York and Pennsylvania were leading grain producing states. The major grains were wheat, oats, rye, buckwheat, and barley. In the last half of the Century, with the occurrence of serious disease and pest problems and the completion of railroads, these two states lost their high ranking in wheat production as the Prairie states became more settled. Other states gained significantly in grain production. Oats particularly remained an important local and regional crop; perhaps because of its low monetary value its marketing was confined to more local areas and of course to the needs of the large horse population, much of which was in the cities. Grain production had notably declined in the two states prior to the present century and corn had a small role in farming (Gates, 1960, pp. 160-174).

Grain received more attention than livestock farming throughout much of the 19th Century. In the Northeast, cattle generally survived by foraging and barely consumed any grain. Grain most generally, therefore, went for human and draft animal consumption. Cattle were transported on the hoof before the railroads in the early 1800s, and the major cities of the Northeast received large numbers of cattle from the Middle West. Partly due to this early western competition in beef cattle marketing, the East never had a beef cattle emphasis, and by the mid-1800s was already turning to dairying; but, because of the rapidly increasing population of the eastern seaboard, only the West could supply the East's needs for meat (Gates, 1960, pp. 200-201 and 208-210).

The capital intensive agricultural component of 1969-1970. As in 1949-50 the second most important component was a measure and index of the comparative position of capital inputs in northern Appalachian agriculture in 1969-1970. This component explained about 25.4 percent of the total variation in the agricultural data matrix, about 2 percent more than was explained by the capital component in the 1949-50 agricultural data (Tables 14 and 19). The mechanization variable, i.e., the average value of implements and machinery, continued to be the highest correlating variable with the component with an $r = .84$, but it did not relate as highly as a measure of capital intensive agriculture as in 1949-50. Nearly as important as mechanization was the land productivity variable which had a correlation over 20 percent higher than in 1949-50.

The relative use of various capital inputs is becoming more directly associated with the amount of agricultural sales per acre, probably to some degree because of the rising costs of capital inputs which now require a farm operator to pay close attention to increasing the number of dollars he can earn from each acre. He will therefore have as a major objective the harvesting of proportionately more cropland in order that he may gain back as much of the cost of his machinery as possible. Thus, percent cropland harvested is an important characteristic of capital intensive agriculture now, although it was not in 1949-50 as farmers have become more like businessmen, concerned about their profits and returns.

More specifically, other capital-related inputs associated with the component were average value of land and buildings and average expenditures for fertilizer. The former is now more important than at the previous time because as agriculture has modernized using more capital inputs, farm buildings have had to be altered and new ones built. For example, the old structures often had layouts not compatible with the needs of barn cleaners, automatic feeders, fodder storing equipment, machinery maintenance and storage. Fertilizer had nearly the same relative importance in capital oriented agriculture as in 1949-50.

Interestingly, two capital input variables that were important in distinguishing capital intensive agriculture in 1949-50, namely, the percent of farms reporting tractors and the average dollars spent for gasoline were not significantly associated with the component. As a high proportion of farms now have a tractor and thus use petroleum products, the relative intensity of capitalized agriculture is not well defined by these variables.

The labor resource. There is some evidence suggesting that the new developments in using capital inputs may require more labor than the earlier mechanization of agriculture which especially caused the underemployment of labor resources on the farm and eventually resulted in massive outmigration. The large rise in the positive association of farm persons per 100 acres with capital oriented agriculture implies that counties with a higher density of farm population on the agricultural land will possess a relatively higher level of capital intensive agriculture. In other words, capital inputs into northern Appalachian agriculture are not as unharmonious with the labor resource as once. Also, associated directly with capital intensive agriculture in 1969-70 was the value of hired labor. The association of labor variables with the capital component could be interpreted in several ways. The earlier over-drain of farm population from the farms resulted in a labor deficit for which a readjustment is now taking place on the farms.

Did consolidation and increase in the physical size of farms result relatively in the greater use of cropland and thus in an overall intensification of agriculture demanding more labor? Over several decades significant decreases have occurred in the pastureland-cropland ratio. There was much more cropland proportionately than pasture in 1970 than 1950 except in a very few counties (Table 25). The increased attention to crops appears to be the major explanation for the expanding importance of labor in capital intensive agriculture as associated negatively with the latter were percent harvested cropland which is hay and the pasture-cropland ratio. Hay is

Table 25.--The County Pastureland/Cropland Acreage Ratios,* 1929, 1949, and 1969.

	1929	1949	1969
Pennsylvania	58.6	48.5	24.0
Allegheny County	55.9	38.1	39.0
Armstrong County	53.7	33.7	27.3
Beaver County	59.5	52.8	35.8
Bedford County	86.1	63.9	24.3
Blair County	45.4	37.5	14.4
Bradford County	90.4	82.2	37.8
Butler County	60.0	41.9	28.4
Cambria County	59.5	40.1	19.6
Cameron County	170.8	88.9	15.1
Carbon County	19.3	27.8	19.6
Centre County	47.4	36.1	14.6
Clarion County	54.1	36.4	31.7
Clearfield County	49.3	34.5	26.4
Clinton County	47.2	29.8	9.8
Columbia County	21.0	17.7	19.6
Crawford County	106.7	86.3	36.2
Elk County	102.9	67.1	12.0
Erie County	88.0	76.4	27.8
Fayette County	93.9	58.3	28.6
Forest County	108.8	70.2	20.4
Fulton County	56.3	45.4	24.3
Greene County	221.3	132.0	61.0
Huntingdon County	68.9	47.8	21.1
Indiana County	51.4	37.2	26.5
Jefferson County	44.6	37.4	22.5
Juniata County	36.7	30.1	13.7
Lackawanna County	109.7	91.7	29.8
Lawrence County	67.8	52.1	30.9
Luzerne County	53.5	36.4	18.6
Lycoming County	47.4	37.0	18.7
McKean County	139.2	92.4	64.0
Mercer County	94.6	71.4	38.9
Mifflin County	42.1	36.2	17.5
Monroe County	42.1	36.2	17.5
Montour County	19.2	15.9	15.1
Northumberland County	15.1	17.2	13.5
Perry County	30.4	21.1	13.7
Pike County	174.4	118.3	16.1
Potter County	142.7	95.8	35.1
Schuylkill County	12.7	15.1	14.4
Snyder County	23.6	20.0	11.4
Somerset County	94.0	70.8	21.5
Sullivan County	160.9	105.9	46.0

Table 25.--Continued.

	1929	1949	1969
Susquehanna County	152.0	134.6	48.8
Tioga County	97.7	95.8	46.1
Union County	15.3	17.7	10.7
Venango County	80.1	55.8	31.0
Warren County	152.6	102.6	39.1
Washington County	123.4	84.5	37.3
Wayne County	200.3	167.6	47.7
Westmoreland County	61.4	42.2	22.7
Wyoming County	104.7	74.7	35.1
New York	89.5	71.5	30.9
Allegany County	110.5	91.0	39.0
Broome County	127.1	108.7	53.0
Cattaraugus County	163.3	127.5	45.2
Chautauqua County	112.2	91.8	35.3
Chemung County	66.4	54.3	32.2
Chenango County	157.2	127.3	49.7
Cortland County	126.9	116.1	49.5
Delaware County	187.2	149.8	54.6
Otsego County	117.6	103.5	43.3
Schoharie County	92.0	78.3	33.6
Schuyler County	50.4	47.6	37.3
Steuben County	67.6	60.2	32.3
Tiogo County	89.1	75.2	34.5
Tompkins County	54.4	50.7	29.9

Source: Data calculated from the U.S. Censuses of Agriculture, 1930, 1950, and 1969.

*Ratio expressed in percent pastureland is of cropland.

ordinarily a forage crop and until recently mostly a single cutting was gathered, but especially since the late 1950s second and third cuttings have grown in importance, signifying the intensification of this aspect of livestock farming. Hay was an extensive crop traditionally but as multiple crops have been increasingly cut off the same land it has become more like a specialty crop--more labor demanding. By the nature of the hay variable which is measured in terms of land, this intensive aspect of hay making is not revealed in this analysis.

Areal patterns of capital intensive agriculture. The mapping of the component scores illustrated some distinct patterns of the relative importance of capital intensive agriculture (Figure 26). The northern portion of the northern Appalachian area is characterized by an agriculture with low levels of capital inputs, except for two areas, primarily Erie and Chautauqua counties, bordering upon Lake Erie, and secondly Tompkins County in south-central New York. In New York State the extreme northwestern area of the Region belongs to two physiographic regions, the "western plateau"--differentiating that area in some respects from the other Appalachian plateau counties of New York--and the Erie-Ontario Lake Plain. For the "western plateau" it has been written:

> Many farmers are increasing their farm capital: barn extensions, new silos, larger herds, and larger acreages are particularly evident in the northeastern part of the region. Because the region has high rainfall, a moderately good lime level in the soil, moderately good soil water-handling capacity, and reasonably favorable topography, many of the new developments in forage varieties and forage handling methods have made it possible for many farmers to increase production and incomes (Nobe, Hardy, and Conklin, 1961, p. 6).

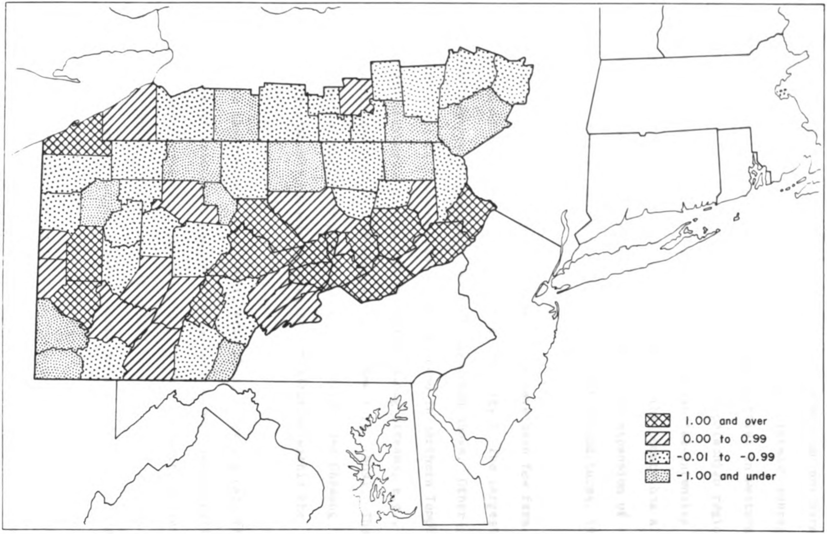

Fig. 26.--Areal Distribution of Component Two Scores, Capital Intensive Agriculture, 1969-1970.

In addition to Chautauqua County, most of the western and northern portions of Cattaraugus County are in the "western plateau" subregion. The county is one of the highest ranking dairy counties in western New York and the only New York County within the Appalachian region which significantly increased the importance of capital-intensive agriculture since 1949-50. The southern part of the county has a rough and mountainous topography; thus, most of the expansion of intensive agriculture has been in the north (Conklin and Lucas, 1952, p. 1).

In the southern tier of New York there have been few farm areas judged as possessing high "economic viability." The largest one is that of extreme southwestern New York, depicted above. Other contiguous areas within counties are to be found in northern Tompkins, western and northern Cortland and in valleys along streams, e.g., in Otsego County and northern Steuben (State of New York, 1969). The declines in the capital component scores of Cortland and Chemung counties are probably closely related to urbanization within the valleys.

With the production of fruit, vegetable, dairy and cash field crops, the Lake Erie shore and plain area has the most varied agriculture in western New York primarily due to the moderating effects of the Lake on the climate (Nobe et al., 1961, p. 7). The Plain has a warmer climate and a longer growing season than the immediate interior areas (Feuer, Garman, and Cline, 1955, p. 1). The frost-free period averages 170 days compared to 100 days for some southern portions of Cattaraugus and Allegany counties, a district which has the shortest growing season in Appalachian New York (Feuer et al., p. 1; Frederick, Johnson, and MacDonald, 1959, p. 13).

The intensive agriculture in Tompkins County is found mostly in the Central Plain of the northern part of the county where dairymen usually grow feed and forage crops to meet their own needs. Many farmers grow only cash crops, e.g., corn, small grains, and beans. Northeastern Tompkins is in the Plateau region and is atypical as intensive dairying is done on well drained soils and favorable topography. Throughout most of the Appalachian Plateau, however, the valleys have soils better adapted to intensive crops, to fertilizer use, and to new farm practices than the hills which tend to be too wet in the spring, too droughty in summer, and too rough of a topography for the use of large farm machines (Linton and Conklin, 1972, p. 3). Thus, favorable physical conditions allows more attention to the production of crops that are generally associated with high levels of capital investment. In addition high capital investment is increasingly associated with favorable physical resources.

> Certain kinds of land have responded more generously than others to increased fertilization and liming, to new species and varieties of plants, and to the use of tractor power and equipment . . . . Modern methods of farming have particularly magnified the significance of the differences in topography, climate, and soil structure. Large, reasonably level fields are needed for efficient use of machinery. Farmers . . . do not have practical means for changing soil structure (Nobe et al., 1961, p. 3).

Dairying is the predominant type of farming in the southern tier of New York and the northern tier counties of Pennsylvania; thus, it is to be expected that low capital component scores would be revealed for most of this subregion's agriculture of the northern Appalachians. Livestock farming in general has been adopting inputs of capital-intensive agriculture at a slower rate than grain farming perhaps for two major reasons. Labor is used efficiently throughout the year in most livestock operations, especially dairying; whereas, in cash-grain farming the work tends to be highly seasonal--only capable of employing persons for a few weeks in preparing the soil, planting, cultivating, and harvesting the crops. Animals need care the year around and more careful attention than machines are able to give. There is a minimum mixing of dairy farming with the growing of crops as dairying is traditionally restricted to areas physically deficient for raising grain crops.

In 1964 within New York, 37 percent of the dairy farms were found in the Plateau area, mostly in the Appalachian Region. Three-fourths of these were hill farms and the rest were valley farms. Many of the farm fields are too small for efficient grain production and the growing season is sometimes too short. However the system of dairy farming does vary somewhat as

> . . . the proportion of the grain requirements that are home produced ranges from "almost none" in the southeastern part of the state to "nearly all" in the western part (Cunningham, 1968, pp. 7 and 12).

The added emphasis on grain growing on dairy farms in western New York adds to the explanation of the high positive scores of the capital component for Chautauqua County and rise in the score for Cattaraugus County. Nevertheless, dairy farming in central New York is considerably more representative of dairying in southern New York, on the Appalachian Plateau, than the dairying of western New York.

The evaluation of the degree of capital intensity in dairying is a complicated problem. For example, on a representative New York

Grade A dairy farm, one-fifth of the cropped acreage is corn for silage contrasted to a similar Wisconsin farm where two-fifths of the cropped acreage is used for both silage and grain. Comparative feed expenditures in central New York are about 3 to 4 times more than in southeastern Wisconsin; however, capital investment in the Wisconsin area is relatively much greater because of the higher value of the investment in land and buildings (Cummins, 1971, pp. 8-9). Therefore, dairying varies as a system of agriculture widely from region to region. As today there is a variety of capital inputs that go into dairying; the relative importance of each has to be considered to assess the overall capital intensity of this type of farming.

In this analysis the capital input variables for 1969-70 associated with the capital intensive component are average value of implements and machinery, average value of land and buildings, and average expenditures for fertilizer; these values are moderately low for those counties where dairying predominates, i.e., the northern part of the Region. Because the dairy farmer infrequently engages in raising grain, he does not have the considerable expense of owning and operating costly harvesting machines. Until recently dairying has utilized considerable labor rather than mechanization in the tasks associated with dairy housing. The market value of the buildings on the dairy farms have depreciated. Most of the buildings were constructed out of wood from the locality or respective farm; but through generally good workmanship, the structures of most buildings have generally lasted more than 100 years with minimal maintenance. Many farm buildings however show neglect. In addition, many of the buildings are now functionally obsolete, e.g., horsebarns, brooder coops, and granaries. Difficult to convert to a contemporary use and too expensive to maintain, many of these outbuildings have fallen into disrepair, distracting from the worth of the farm property. Often the farm houses have gone unrepaired while further investment was made in the business of farming. Except for northern New England, New York and Pennsylvania have the lowest farm real estate values in the Northeast (Clifton and Crowley, 1973, pp. 3-13).

Land values have remained comparatively low for several reasons. Although most of the counties of the central portion of New York's Appalachia have growing cities, the apparent minor effect upon the capital component values may be explained partly by the adverse effect urbanization has on a farmer's willingness to invest in his farming if he perceives that he will lose his farm to the "developers." As the farm program benefits of the government primarily assisted farmers raising cash crops, the area's farmers with a livestock emphasis did not see much "capitalization of farm program benefits into land values" (Reinsel and Krenz, 1972). In dairy farming because of the use of animal wastes on the fields, there is less need for purchased fertilizer than in crop farming. Therefore, for a number of reasons capital investment in dairying in the northern Appalachians tends to be below that of other types of farming, particularly that which is more crop related.

Two factors not previously mentioned undoubtedly affected the capital investment in northern Appalachian dairying during the 1960s. Significant declines in the number of commercial dairy herds in

Pennsylvania began in the late 1950s and continued through the 1960s (Table 15). Many dairymen, especially the older individuals, practiced disinvestment in order to meet the "cost-price squeeze" and to continue in dairying long enough to retire. A large proportion of the dairy farms that went out of this type of farming were operated by the older farmers who after retirement or death were not followed by a successor. Another event which had an important effect upon investment in dairying and the decline in the number of dairy farms was a major drought, the longest and most severe in Pennsylvania history, which prevailed during the first half of the 1960 decade (Dorman, 1966, p. 2; Miller, 1966, p. 13; Kauffman, 1966, pp. 34-35).

A large subarea situated in the central and southeastern parts of the northern Appalachians contains types of farming characterized by high and moderate values of capital inputs (Figure 26). These contiguous counties are east of the Allegheny Front and primarily in the Ridge and Valley physiographic region of Pennsylvania. The more eastern counties of the group are within the Pocono Plateau region. The former counties contain much of the best agricultural land found in the Northern Appalachians mostly because of the limestone based valleys situated between the mountain ranges. Agriculture is mostly restricted to these valleys as the mountains often rise abruptly from the valley's sides. Many counties benefit from the good farm lands associated with the West and North branches of the Susquehanna River. The concentration of agriculture in the valleys on superior soils presents a set of physical conditions especially rewarding for the adoption of various capital inputs and the new agricultural technologies. The terrain is favorable to the expansion of mechanization. The soils respond well to the application of commercial fertilizer. Farming in this section of Pennsylvania is quite unlike any other place within the study region. A large part of the area has poultry farming. Field crops, vegetables, and horticultural products are a larger proportion of total sales for most counties than in Pennsylvania as a whole (Table 26). A generality developed earlier in this study appears to have relevance here; the more crop farming within an area the more capital intensive agriculture is practiced.

A comparison of the capital input maps of component scores for 1949-50 and 1969-70 does not reflect the relative decreases occurring in half of the counties in the southeastern and central portions of northern Appalachia through this score of years (Figure 23 and Figure 26). Most of the counties with declines in capital investment have an agriculture primarily described as either dairy and poultry, or poultry alone. These counties are: Carbon, Columbia, Juniata, Montour, Northumberland, Perry, and Schuylkill. These diminished capital investment values should be seen in a comparative sense. A number of the counties scored high on degree of mechanization in 1949-50 but as the other counties became more mechanized, the counties under consideration became less different than other counties in this investment. Because of the rising importance of other capital inputs, mechanization contributed less to the formation of a total measure of capital intensive agriculture in 1970 than in 1950. In contrast, the value of farm real estate became more

Table 26.--Sales of Crops and Crop Sales as Percent of Total Sales in the Southeastern Counties of the Northern Appalachians, 1964.

County	Total Sales	Total Crop Sales	Crop Sales As Percent Of Total	Field Crops	Vegetables and Potatoes
Carbon	1,960	542	27.7	219	100
Centre	10,462	1,507	14.4	896	269
Clinton	3,012	555	18.4	321	136
Columbia	10,652	3,410	32.0	949	878
Juniata	6,630	768	11.6	416	69
Lackawanna	5,577	1,136	20.4	154	518
Luzerne	8,896	4,120	46.3	527	2,138
Lycoming	9,616	2,028	21.1	836	466
Mifflin	8,189	546	6.7	292	107
Monroe	2,983	1,200	40.2	311	309
Montour	2,673	467	17.4	304	77
Northumberland	11,880	2,803	23.6	877	601
Perry	8,379	961	11.4	565	48
Pike	1,605	68	4.2	22	11
Schuylkill	11,056	3,126	28.3	940	1,408
Snyder	7,978	1,179	14.8	476	162
Union	5,853	786	13.4	507	168

Source: Pennsylvania Statistical Abstract, 1967, p. 282.

important in 1970 than 1950 in establishing a collective measure of capital utilization in agriculture. Nevertheless, the counties in the southeastern portion of the study area continued to maintain a strong comparative edge in capital investment. Some of the counties actually had very significant increases since 1949-1950 in this respect, e.g., Blair, Clinton, Monroe, Pike, and Snyder.

The last major agricultural area discussed, southwestern Pennsylvania, had some counties with high and moderately high component scores of capital intensive agriculture. Allegheny County, containing Pittsburgh, and the counties close by, Beaver, Butler, Lawrence, and Westmoreland had exceptionally high measures of mechanization and real estate values. High values for some crops tended to raise the land productivity association with the capital investment component. Allegheny and Indiana counties had especially large values of vegetable production per acre in 1965 and there were nearly equivalent acreages of vegetables of roughly a square mile each in Lawrence, Butler, Cambria, Washington, and Westmoreland counties (Table 27). The value of field crops per acre was especially high in Lawrence, Butler, and Cambria counties. The total sales of horticultural specialties was very high in Allegheny and Butler counties and important in Indiana and Westmoreland counties in 1964. Indiana and Somerset counties had the highest forest product sales, including Christmas trees in the State in 1965. The counties in southwestern Pennsylvania with low capital component scores, Fulton and Greene, were generally more livestock oriented. Greene and Washington counties raised sheep which helped to reduce the mechanization needs.

Table 27.--Value and Sales of Crops in Southwestern Pennsylvania, 1964 and 1965.

	Value of Vegetables Per Acre	Acres of Vegetables Harvested	Value of Field Crops Per Acre	Total Sales of Horticultural Crops	Total Sales of Forest Products	Total Agricultural Sales
The State	$ 264	65,510	$ 67	$78,696,000	$6,860,000	$782,582,000
Allegheny County	381	1,120	42	4,834,000	13,000	8,699,000
Armstrong County	178	120	47	220,000	54,000	5,383,000
Beaver County	212	180	51	308,000	19,000	3,722,000
Bedford County	171	230	54	25,000	312,000	11,468,000
Butler County	211	630	61	6,015,000	88,000	15,391,000
Cambria County	204	710	74	575,000	93,000	6,251,000
Fayette County	169	380	49	281,000	162,000	5,628,000
Fulton County	152	60	50	27,000	133,000	4,328,000
Greene County	180	20	39	15,000	36,000	3,435,000
Indiana County	344	600	54	1,805,000	532,000	10,752,000
Jefferson County	157	60	48	357,000	146,000	5,225,000
Lawrence County	145	730	61	710,000	30,000	6,734,000
Somerset County	169	440	50	370,000	490,000	16,208,000
Washington County	246	710	48	918,000	40,000	11,690,000
Westmoreland County	233	560	49	1,272,000	57,000	13,261,000

Source: Pennsylvania Statistical Abstract, 1967, pp. 280 and 282.

Specialization in selected crops was associated positively with capital dependent agriculture.

The labor oriented agricultural component in 1969-1970. The third most important component of agriculture in 1969-70 explained more than 12 percent of the total variance found in the agricultural variable data. This dimension of agriculture had a strong labor input as labor productivity had an $r = .73$ and the value of hired labor had an $r = .58$ with the component (Table 19). The two labor variables had the highest association with the component; thus, this dimension of agriculture was primarily under the influence of labor inputs. Other variables somewhat related positively with the labor component were the pastureland-cropland ratio and the ratio of farm expenditures to the value of agricultural production. Therefore, counties with a major type of farming favoring the use and retention of pasture would have higher labor component scores. Where this component is of high value, the margin between farm expanses and gross farm receipts would be narrow.

In 1970 there were fewer counties in the category of highest component scores and there was less positive association with urban areas than in 1950 (Figures 24 and 27). Fundamentally, however, there were few changes in the basic patterns of component scores. A large area in the easternmost part of the northern Appalachians retained moderately high and positive scores. Because of the strong position of specialized dairying in the northern two-thirds of this area, most of the labor had to be concentrated in milk production, especially in the New York State counties and in Pennsylvania's

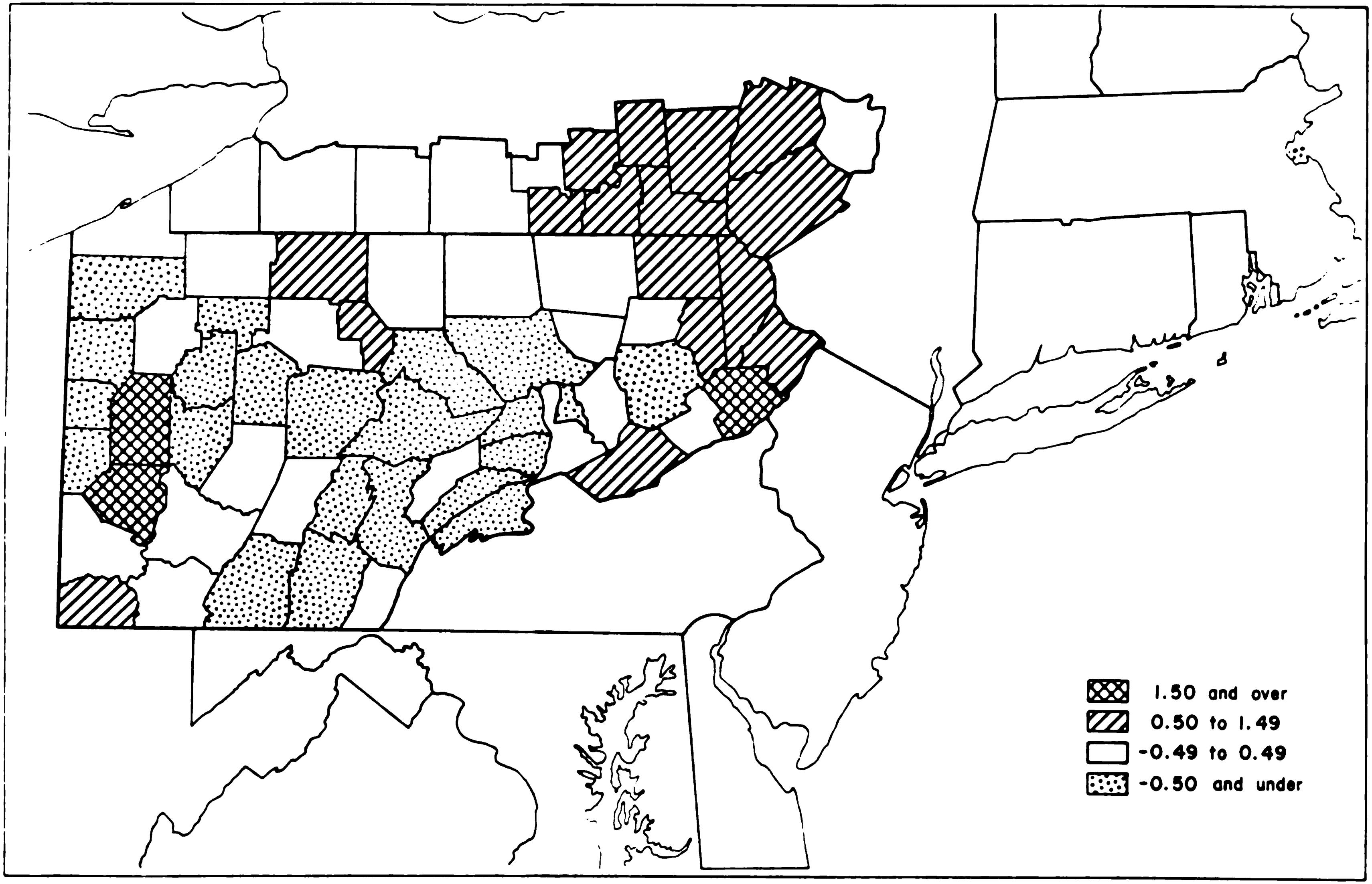

Fig. 27.--Areal Distribution of Component Three Scores, Labor Oriented Agriculture, 1969-1970.

Susquehanna and Wayne counties. Dairy farming characteristically uses labor more efficiently than do most types of farming as there is necessary work to be done on the farm the year-around, regardless of the weather and under careful management nearly an even percentage of the cows can be producing at any time of the year, establishing an even flow of income throughout the year. Because of the necessity of working a seven day week for fifty-two weeks in a year, some dairymen and their families find it impossible ever to be away from the farm for a few days of recreation and vacation unless they have obtained and trained hired help for a period of time. Traditionally there were few occupations anymore confining than dairying. Many of the smaller dairy operators who were less able to afford or to obtain hired labor probably vacationed with their families only once or twice in a lifetime, if at all. Very few dairy farm families even had the short time required for eating out at a restaurant. These are a few of the many peculiarities of the general way of life as lived by the traditional dairy farm family that undoubtedly the many urbane people of today would find difficult to understand and accept, but for the most part were accepted by the farm folk as just a part of regular living.

The largest change in the patterns of the scores between 1949 and 1970 involved the counties of the southern tier of New York and the northern tier of Pennsylvania where the increasing importance of the labor component, presumably to a major extent because of the use of more hired labor, was nearly all inclusive and quite striking (Figures 24 and 27). The north central portion of the Region had an increase in the labor scores but a decrease in the capital input scores.

In this northern area of the northern Appalachians it may be that capital inputs have been found not to be as adaptable to the systems of farming, the agrarian way of life, and the physical environment as labor, and there has been a resultant movement back to the use of more labor compared to capital, but final conclusions on this subject can not be rendered in this analysis because the composition of the labor component in 1970 varies somewhat from its counterpart of 1950. One way of testing such a hypothesis would involve correlating the changes in the different measures of labor and capital inputs for similar areas and the Region from 1950-70. It is quite likely that different results would be obtained for various capital inputs and that the correlations of these with labor for certain groups of counties would be higher than the Region's correlations.

The Regions' linear correlations among three variables included in this study as listed in Table 28 are suggestive of some of the thoughts given above. Although the correlations are low, there appears to be some increase in hired labor as mechanization rises. Nevertheless, there is an extremely low relationship between investment in implements and machinery, and labor productivity which is contrary to theory. Writings frequently state or imply that because of modern equipment and science applied, the average American farmer has very high values of productivity enabling him to produce enough to feed several dozen people. This low degree of association may

Table 28.--Linear Correlations between Capital and Labor, 1949-50 and 1969-70.

Year	Numbers 6 and 10: Value of Implements and Machinery/Value of Hired Labor	Numbers 6 and 19: Value of Implements and Machinery/Labor Productivity	Numbers 10 and 19: Value of Hired Labor/Labor Productivity
1950	.403	.133	.301
1970	.369	-.006	.610

Source: Basic data for variables calculated from United States Censuses of Agriculture, 1950 and 1969.

mean that in general the Region is not well suited to the successful application of the American type of mechanization and the full benefits of using such cannot be achieved; therefore, where over-mechanization has occurred in relation to incompatible physical resources, negative returns occur or relatively small amounts of increased production take place as a result of the additional use of mechanization. Perhaps, for the use of machines, the point of diminishing returns was confronted some time ago. Another possible explanation is that although many persons have left the farm, mechanization may not have displaced relatively as many people in this Region as in other areas of the Nation, thus, production would be divided among more persons. The third and last association reveals the increasing importance of hired labor in expanding labor productivity, and supports the relatively greater use of labor than capital inputs in the northern portion of the Region.

Some kinds of farming are particularly demanding of both capital and labor inputs. In the northern Appalachians this seems to be true for the specialty crop and vegetable farming areas, especially near large cities, e.g., Pittsburgh, Johnstown, Altoona, Scranton, Wilkes-Barre; but also near the numerous smaller cities and in the anthracite coal fields. The major changes from 1950 took place in Luzerne and Blair counties, the sites of Wilkes-Barre and Altoona, respectively, where labor declined in importance but capital inputs remained high (Figures 23 and 26; Figures 24 and 27).

Two areas, differing physically and agriculturally, had most of the negative component scores in 1950 and 1970. The majority of the counties in the Ridge and Valley province of central and eastern Pennsylvania had negative labor scores in both years. Many of these counties, however, utilized many capital inputs as they gave good returns from the valley soils. This part of Pennsylvania had a concentration of poultry, dairy, and a combination of the two; nevertheless, here is located the largest concentration of grain crop production within the State outside of southeastern Pennsylvania. Grain cultivation was mechanized very early in the agricultural revolution beginning around Civil War times, and has become more capital oriented than most types of farming. This area has the largest area of poultry farming within Pennsylvania and a large area where both dairying and poultry are common. Poultry raising has significantly expanded in Pennsylvania through several decades; and "probably in no other branch of farming has progress been so rapid and changes so revolutionary." Intensive specialization and contract farming has especially been characteristic of this type of farming and generally the distribution of poultry corresponds with the major distribution of corn and grain production (Wrigley, 1946, pp. 29-31; Alexander, 1963, pp. 202-203 and 208-209). Since the late 1940s and the early 1950s much labor saving technology has become a part of poultry farming as considerable production research resulted in the development of new production systems and techniques (Bressler, 1950).

The other area which has had relatively low labor use is in the western portion of the Appalachian Plateau, excluding the environs of Pittsburgh. This is an area of semi-agricultural activity and general farming where one-third to a half of the land is cultivated but there is an intermixture of pasture and woodland subject to grazing (Pa. Stat. Abs., 1967, pp. 278 and 281). This is an interesting part of Pennsylvania agriculture because it is a system of farming that was neither depicted as capital intensive or labor demanding in either 1950 or 1970. Thus, in this area the major input into farming continues to be the land, and the farming is therefore of an extensive nature.

<u>The residential farming component of 1969-1970</u>. Although this type of farming is still of little importance overall in the Region's agriculture as it accounts for less than 10 percent of the total variance in the agricultural data, it is nonetheless a slowly growing segment of the total agricultural picture in the northern Appalachians (Tables 14 and 19). Probably much of the importance of this general kind of farming with its variant subtypes is concealed by the fact that some can meet the minimum qualifications to be classified as commercial farms. Some of these farms presumably fall into the 1969 Census of Agriculture's part-time and part retirement

classes. Others are undoubtedly "tax write-off" farms. For example in 1950 the variable with the highest correlation with this component was the ratio of farm expenditures to the sales value of agricultural products, meaning the margin between farm expenses and gross farm sales was rather small. This variable was of second importance in 1969-70. The variable with the highest association with this component was the percent of farms reporting trucks with an $r = .64$; thus, the truck ownership variable was the second most important characteristic of the component in 1949-50.

The possible role that trucks perform in this agricultural system is suggested by the patterns of the component scores. Several clusters of contiguous counties are depicted. Counties of northwestern Pennsylvania, Cameron, Elk, McKean, and Potter and also the counties of Monroe and Pike of east central Pennsylvania had above average positive scores. These two areas, the first in the Appalachian Plateau and the second on the Pocono Plateau are similar in many ways. Good agricultural land is at a premium; soils are generally poor; outdoor recreational activities prevail; there is a large proportion of the land that is wooded; the average value of farm production per farm is low. In such a rural economy, the truck is an all-purpose and utility vehicle. The farms of the northwestern portion of the Appalachian Plateau in Pennsylvania are among the largest in physical size within the State, e.g., Potter had the largest farms in 1969; thus, a truck can serve as transportation on the farm. The area also has the most isolated situation in respect to accessibility to cities; consequently few cityward trips are made and a car is not as necessary.

Two other groups of counties had high component scores: one located in the eastern portion of central Pennsylvania and the other in south-central New York. Both areas are similar because of significant crop and grain production. The Pennsylvania area has considerable poultry farming. Apparently, these farming activities have a greater use for trucks than other kinds of farming. Lastly, in the eastern portion of the Appalachian Plateau in southern and central Pennsylvania several counties had moderately positive values for this component, and here as in the above mentioned areas, it is surmised that the presence of trucks on the farms is a good indicator of the relative importance and dominance of local markets.

<u>The "Corn Belt" agricultural component of 1969-70</u>. Although this component explained only somewhat more than 6 percent of the total variance in the agricultural data matrix, there are indications to the effect that if additional variables had been included in the analysis, especially ones related to crop production, the value of this component in describing the Region's agriculture would have significantly increased. Given the above and the writer's conviction that this component will become a much more important part of the northern Appalachian agricultural activities, some of the recent development associated with it, the facts, and the implications involved are presented in this section of the study.

The agricultural variable most related to the component is the number of bushels of corn per harvested acre or corn yields with an $r = .64$. Other variables correlated with the component are the county average value of hired labor per farm reporting and the county average of labor productivity per farm, both with an r = .43. Naturally as yields are significantly increased, more hired labor can be afforded and the relative amount of sales per farm person, i.e., the measure of labor productivity, will considerably increase as it is highly unlikely that additions in labor will come very near the rate of the growth in crop yields.

One of the curious aspects of this components characteristics is the total restriction of the moderate and high scores to the western half of the northern Appalachians. Corn requires a large input of land and the land tends to be more available in the western part of the Region than in the eastern portion. The highly specialized dairy counties are poorly represented by this component.

Appalachian farmers seem to be adopting more of the ill-advised practices of some of cash grain farming found in the mid-western United States. Cropland is relatively scarce in the East and particularly so in the Appalachians; and yet, the new agricultural techniques are primarily fitted for the best land, the cropland. Thus, to maintain production using the new costly technology, extraordinary pressure is exerted to increase yields on the limited cropland. Most farmers have become market oriented; consequently, they are today more production minded.

In the shortrun a farmer can "mine" his soil and obtain more production. This questionable practice may become an increasing problem in the Region if corn is grown continuously on the same fields for several years. The use of large amounts of fertilizers replace most of the nutrients; but, additional erosion, sedimentation, and excessive fertilization may cause pollution and eutrophication.

Why is there a new emphasis on growing crops in the Region? As nothing as spectacular as production increases in crop farming have come from the use of the new technologies in livestock farming, except for that associated with fowl production (Durost and Bailey, 1970, p. 5), it appears that farmers are adopting the crop technologies that can be fitted into their farming operations. Unfortunately, the traditional benefits of conservation associated with dairy farming would be significantly reduced if the technologies first used in crop agriculture were primarily accepted.

Although on a necessarily lower scale, as the physical resources in Appalachians are much less favorable than those of the Middle West, it appears the farmers of the northern Appalachians are adopting Corn Belt agriculture. Concerning that most important crop of the Middle West, it has been recently written:

> Up to World War II, corn typically was grown in a three year rotation of corn-oats, clover, without fertilizer . . . and the Corn Belt yield was about 38 bushels an acre.
>
> Today, corn is seldom rotated. Leading growers typically fertilize with 150 pounds of nitrogen . . . . The average Corn Belt yield is now 90 to 100 bushels (Durost and Bailey, 1970, p. 3).

Granted this is a brief capsule of Mid-western agriculture, but some useful insights evolve when an analysis is made of this kind of agriculture. With the emphasis on all out production, regardless of the basic motivations, the Corn Belt syndrome of farming exemplifies how easily rotation practices, and anti-erosion and conservation techniques, may receive secondary consideration.

Years of agricultural policy based upon the political expediency of providing the cheapest possible food have greatly encouraged the emphasis on agricultural productivity. Thus, most concerns have been suppressed, including conservation, to the achievement of the highest possible production; but, because the per unit return to the farmer was generally at a minimum, the farmer has had to produce a large number of units to earn enough to be financially solvent. Systems of agriculture have been forced on many farmers by exogenous factors.

What evidence is there that northern Appalachian agriculture is becoming more like that of the Corn Belt? Most surprisingly, yields of corn as grain in two-thirds of the counties of the Region in 1969-70 corresponded very favorably with the average yields per acre in the Middle West. The yields doubled between 1949 and 1969 (Table 29). Total production has continued to increase, expanding by nearly 42 percent in the short and recent period of 1964 to 1969 for all farms within Pennsylvania (Table 30). Total acreage of corn in the State declined by about 20 percent, but this decrease was very nearly made up by increases in sorghum and soybean acreage. Acreage of field corn for grain however actually advanced. Nearly half of the loss of acreage in corn for forage was made up by the increase in the acreage of sorghum forage and there was a growth in the aggregate quantity of corn forage produced in Pennsylvania in 1969.

Two major facts are important in indicating the direction of Pennsylvania agriculture in general, i.e., on all farms. Production from special forage crops, e.g., corn and sorghum was maintained and

Table 29.--Average Yields of Corn Harvested for Grain per Farm in Selected Counties, 1949 and 1969.

	1949	1969		1949	1969
	(bushels per acre)			(bushels per acre)	
Pennsylvania	49	91	New York	47	88
County			County		
Armstrong	46	95	Allegany	48	105
Beaver	46	93	Broome	46	96
Bedford	45	100	Cattaraugus	51	97
Blair	51	110	Chautauqua	44	103
Butler	51	100	Chemung	52	94
Cambria	48	94	Chenango	54	98
Cameron	44	110	Delaware	41	98
Centre	49	102	Otsego	50	99
Clarion	46	110	Schoharie	46	118
Clinton	45	102	Schuyler	44	109
Crawford	54	102	Steuben	48	92
Elk	41	108	Tioga	46	96
Erie	51	97			
Fayette	49	91			
Forest	44	110			
Huntingdon	47	100			
Indiana	46	99			
Jefferson	47	106			
Juniata	48	105			
Lawrence	50	111			
Lycoming	48	96			
Mercer	50	112			
Mifflin	52	108			
Perry	46	94			
Potter	41	105			
Snyder	47	97			
Somerset	47	101			
Tioga	43	94			
Union	48	94			
Venango	48	99			
Warren	46	95			
Westmoreland	47	93			
Wyoming	42	105			

Source: Data calculated from the U.S. Censuses of Agriculture, 1950 and 1969.

Table 30.--Trends in Corn Production in Pennsylvania, 1944-1949 and 1964-1969.

	1944	1949	1964	1969
Total Cropland	8,001,335	7,944,850	6,042,810	5,597,790
% Cropland Harvested Corn	17.76	15.88	18.57	19.65
Total Acreage	1,421,092	1,261,646	1,121,951	1,100,205
Harvested grain	1,113,877	1,007,162	776,745	782,937
Cut for silage		239,357	345,206	327,268
			(319,199)	(303,204)
Total Production				
Grain (bu)	39,631,511	49,509,946	50,456,500	71,400,446
Silage (tons green)		2,104,699	(3,399,684)	(4,417,680)
Yields Per Acre				
Grain (bu)	35.58	49.16	64.96	91.20
Silage, tons		8.79	(10.65)	(14.57)

Source: Calculations based upon U.S. Censuses of Agriculture, 1945 and 1969.

Note: ( ) data for Class 1-5 farms, generally commercial farms as defined by the Census of Agriculture.

increased while both acreage and tons of hay declined, 24.7 percent and 5.2 percent, respectively, and the census category of "all other land," primarily being pasture but including woodland pasture, declined by 38.8 percent. Secondly, two market valuable grains, corn and soybeans, were produced in record quantities. Corn raised for grain yielded almost 42 percent more bushels in 1969 than 1964. Soybeans for beans expanded. Acreage went up by over 42 percent and bushels produced climbed 156.23 percent. These figures clearly disclosed a major intensification of agriculture in Pennsylvania with specially significant growth of corn and soybeans for grain. These two crops, of course, form the base of the Mid-western agriculture.

As would be expected the five largest classes of farms, the most commercialized and with the largest sales, became more like Corn Belt farms than did farms in general in the State in the late Sixties (United States Census of Agriculture, 1969). These farms accounted for 93.4 percent of the corn produced for grain and 92.3 percent of the soybeans for beans produced in 1969. Between 1964 and 1969 total production of corn for grain rose 48.4 percent compared to nearly 42 percent for all farms and the acreage of corn for grain expanded 6.3 percent. Unlike all farms together, the five largest commercial farm groups had an increase of 3.3 percent in acreage devoted to field corn for all purposes. The tons of corn used for silage however grew by nearly 30 percent. The production of soybeans for beans at 161 percent of the 1964 harvest was similar to the production growth of all the farms. The very large recent increases in two favored feed grains on the most commercialized farms in Pennsylvania quite interestingly confirms the general trend of agriculture in the area away from dairy farming and the raising of cattle--what in the past has been called the best use of the land because the physical elements of the area were especially fitted to the production of large quantities of grass and hay. Yet, these resources, once available in superabundance are being used less and less. The acreages of all major types of hay declined. Only clover and timothy showed an increase in quantity produced, but this was more than cancelled out by the fall in alfalfa and alfalfa mixtures. There was 9.7 percent less pasture acreage in 1969 than in 1964. Pastureland and rangeland (other than cropland and woodland pasture) acreage shrunk 49.4 percent while cropland used only for pasture or grazing climbed by 76.7 percent, but this increase in the latter only made up somewhat more than two-thirds of the acreage lost in permanent pasture.

The increasing intensification of agriculture in Pennsylvania and the northern Appalachians which make up a large part of the State raises some exceedingly important questions. Soil erosion has been given as a local cause of migration to the city (Bowman, 1934, p. 92). In the history of United States agriculture, some cropping systems have been especially associated with erosion, e.g., in the South the crops cotton, tobacco, and corn contributed to serious soil losses. Corn, as a row crop permits considerable erosion. In the 1950s some monoculture was being practiced and advocated, but one of the biggest disadvantages in addition to serious erosion problems was the need for a complete and timely application of nitrogen to the soil (Allaway, 1957, pp. 386-395).

In the 1930s much concern over the considerable erosion taking place in the central prairies or the Corn Belt was being voiced (Bennett, 1939, pp. 685-694; Leighly, 1967, p. 152). Because of the depth of the soil in many parts of the Middle West, the rather large loss of soil, although in relative terms of a moderate quantity, has been perhaps overlooked. Although much is known on how to control erosion in the Middle West, less than the desired quantity of these practices have been implemented because ". . . of a lack of substantial monetary return to a farmer" for doing so (Council on Environmental Quality, 1971, pp. 31-33). Given that rotation practices have fallen short of their ideal use in "Corn Belt" agriculture, what are the probabilities that serious erosion will occur before the alternative methods of conservation now known will be applied by the farmers (Barnes and Blakely, 1971, pp. 289-293). If erosion is greatly reduced, will not continuous and double cropping exhaust the soil? Is an agriculture practiced on the relatively level terrain of the Midwest feasible on a topography as uneven as that of the study area?

Before generally answering the preceding questions, it should prove helpful to ask: is intensification necessary and why is the trend of agriculture in this direction? The following gives some answers:

> Population explosion; more mouths to feed. Rising labor costs; a narrow margin between cost and returns of production. These are some of the reasons why many farmers intensify their operations and crop their land more intensively (Barnes and Blakely, 1971, p. 289).

In the East, in addition to corn, more of some feed grains are now (in the 1970s) being raised because of the skyrocketing prices of feed grain and high-protein feeds which have doubled and nearly tripled, respectively (Figure 28). The milk-feed price ratio has now reversed its direction; a pound of milk is no longer worth more than a pound of concentrate ration fed to milk cows (Figure 29). These are ominous signs for the future of dairying in the northern Appalachians. Undoubtedly, a major cause for the expansion in certain grain production within the Region in the late 1960s was the general and major increases in feed consumption (Figures 30 and 31). This general intensification of grain feeding probably motivated many of the Region's farmers to expand grain production in the late 1960s. As has been noted, large quantities of purchased feed grains have a long history in the study area. Nearly a half century ago this tendency was observed

> . . . with the increased demand for dairy products and with better facilities for transportation there has been a decided tendency on the part of farmers to buy western grain and raise only the necessary roughage on their places. This has enabled them to carry much more stock.

The same writer also expressed the seriousness of the neglect of pastures in the Northeast which resulted in many "worn-out pastures" (Colby, 1926, pp. 208-209). The abandonment of nearly 50 percent of the permanent pastures in the study area during the late 1960s suggests that relatively little has been done since the 1920s to improve these lands. As much of the Region has considerable relief, pasture was often restricted to the hilly and rough lands. The question of the effect the adoption of tractors and additional machinery had on the preservation of pastures should be investigated. Consideration

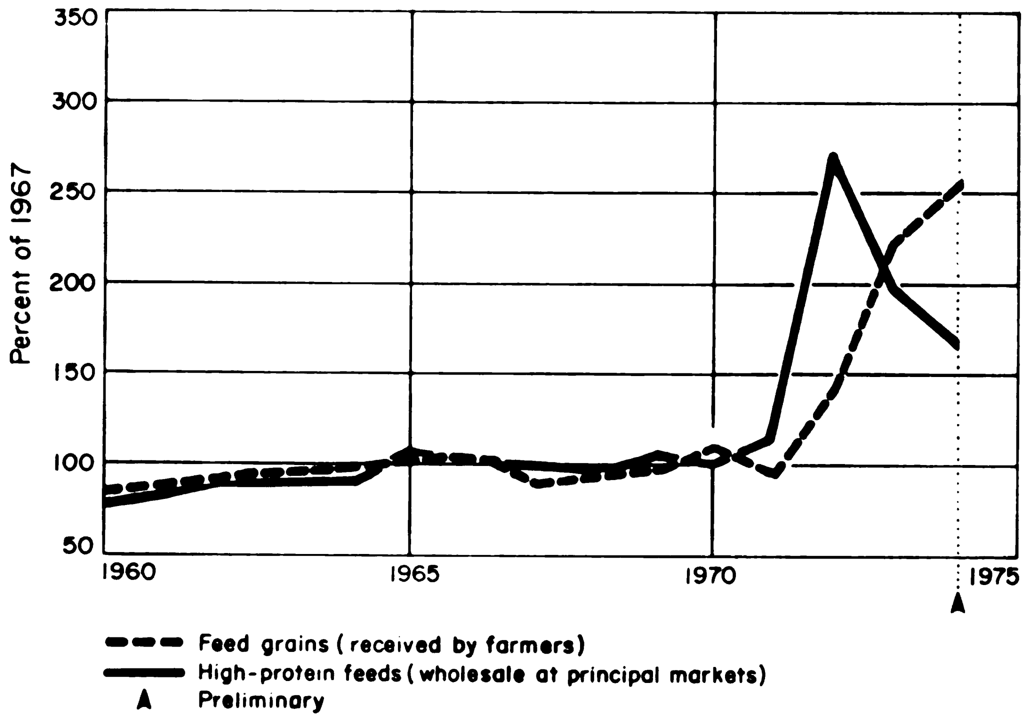

Fig. 28.--Price Trends of Feed Grains.

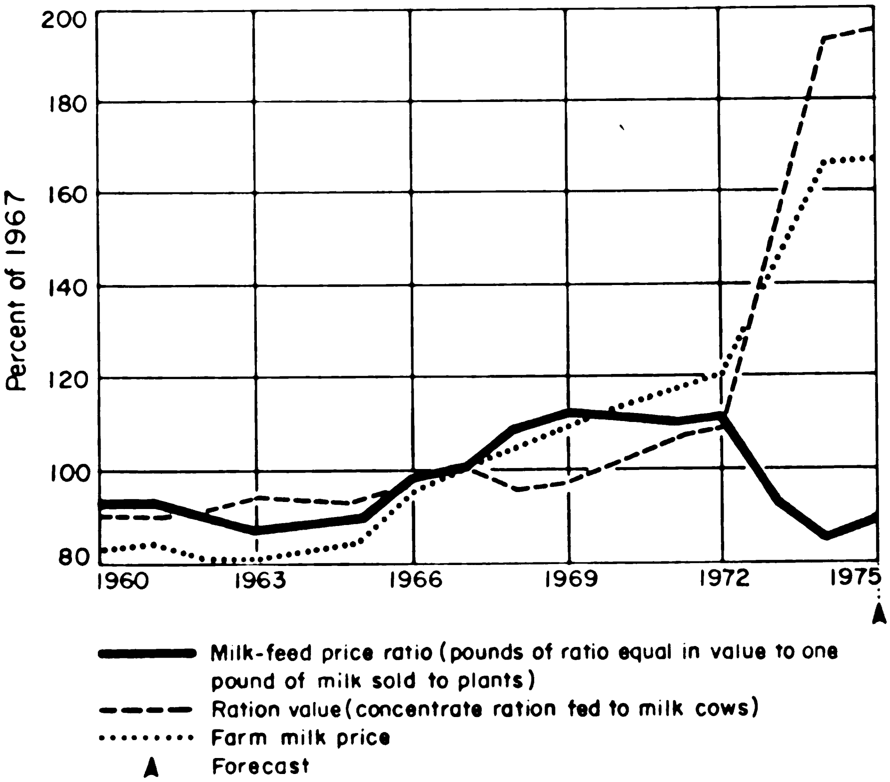

Fig. 29.--Milk-Feed Price Ratios.

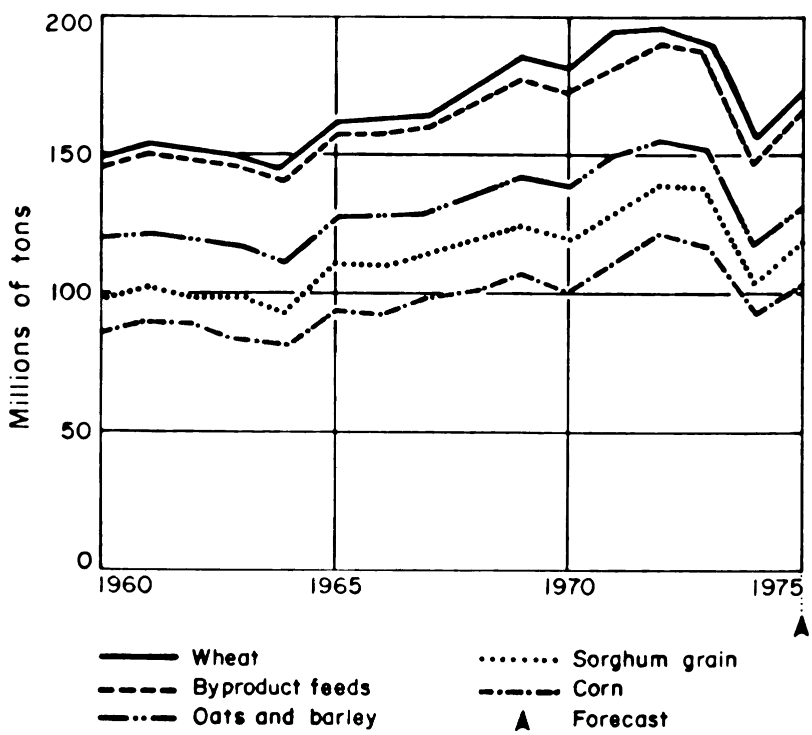

Fig. 30.--Trends in Feed Grains Consumed.

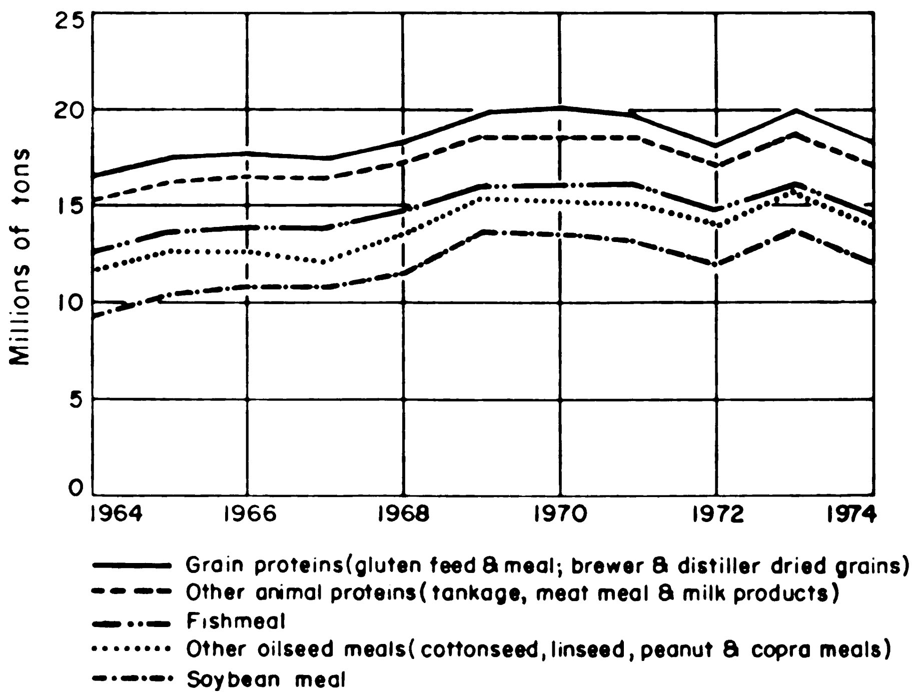

Fig. 31.--Trends in Sources of Protein Consumed.

of this question is given in the following discussion of the last component of northern Appalachian agriculture in 1969-70.

The mechanization and motorization component of 1969-1970. This component accounted for more than five percent of the total variance, a small sum, but the association r = .68 of percent farms owning tractors with it and the areal distribution of the component scores, requires at least some description (Table 19). Interestingly, the variables having the next highest correlations with the component, percent farms reporting trucks and also autos, gave the component a strong motorization appearance.

As the highest and moderate component scores are primarily located in counties of the northwestern and northeastern portions of Pennsylvania and a few adjacent counties of New York where specialized dairying dominates the agriculture, a major implication is the exceedingly important position that the tractor occupies in the dairying activity. The tractor is heavily relied upon in the rising harvests of forage crops on such farms. Certainly it is the single most important investment on dairy farms; however, as previous analysis of the data has illustrated, the expanding range of possible inputs into farming has lowered the relative importance of the tractor as a single indicator of capital investment.

As the dairy areas of the Region had traditionally a large percentage of its farm lands in pasture, interaction between pasture land continuance and use and tractor power necessitates consideration. Did the expanded use of tractors and other machines distract from the proper utilization of pastures? Some evidence suggests that the abandonment of pastures was partially related to the increasing adoption of the tractor. Correlations between percent of farms reporting tractors and the pasture-crop land ratio give a change of relationship starting with a moderately negative relationship in 1929-30 to really no relationship in 1969-70 (Table 31). This may mean that the pastures with the most adverse topography and with the poorest grass production were abandoned to the greatest extent soon after the initial phases of tractor adoption. The use of tractors released some cropland that had been used for horses, but it also resulted in some growth in production from cropland. Therefore less pasture land was needed. In general it appears that value of machines and implements on farms has continued to be associated with a decreasing pasture-crop land ratio (Table 31).

Table 31.--Temporal Correlations Between the Degree of Tractor Acceptance or Mechanization and the Pasture-Cropland Ratios.

Year	Percent of Farms with Tractors with Pasture-Crop Land Ratio	Average Investment of Machinery and Implements Per Farm with Pasture-Crop Land Ratio
1929-30	-.57	-.21
1949-50	-.37	-.53
1969-70	.08	-.48

CHAPTER 8

EXPLANATIONS FOR PERIODIC AGRICULTURAL POPULATION CHANGES IN THE NORTHERN APPALACHIANS, 1909-1970

Form of the Explanation

To what degree through time for the several areas of the northern Appalachians are the major characteristics of agriculture associated with the relative preservation or loss of farm population? The agricultural characteristics are derived from a principal components analysis of selected agricultural variables for each of four time periods. In the preceding chapters these grouped characteristics, i.e., components, are interpreted and geographically analyzed with the expectation that such analysis of the Region's agriculture would lead to additional hypotheses for the varying farm population changes.

Relative change in agricultural population is measured as the percentage each corresponding agricultural population of a county is of that of a previous census. Thus, an indicator of the relative degree of "farm population retention" for each county within the study area results.

Principal component analyses of agricultural data for each of the 1909-10, 1929-30, 1949-50, and 1969-70 periods produced component scores which are the inputs for stepwise multiple regression and serve as independent variables. The farm population retention percentages represent the dependent variable, i.e., farm population change, for each of the major time periods. The results of several exploratory stepwise multiple and linear regressions using component scores of one period with agricultural population change of a subsequent period are presented in a special effort to determine if changes in farm populations occur relatively a short while after alterations in the agricultural systems or whether in actuality a considerable time lag in reaction represents reality. If significant high or moderate coefficients of multiple correlation (R's) are obtained from a stepwise multiple regression, the results of an analysis of mapped residuals are presented.

The Nature and Application of the Stepwise Regressions

First, a brief and general statement of the function of a stepwise multiple regression is necessary to the clarification of the analysis applied in this study. For each selected time period, each independent variable, as in this study an agricultural component, is chosen sequentially according to its importance, that is in the reduction of sums of squares (Wittick, 1971, p. 6). For each particular time period, the independent variable first chosen is the one that has the leading simple correlation with the dependent variable (King, 1969, pp. 145-148). The independent variables, i.e., the agricultural components, are considered and entered into the regression in turn and sequentially according to the one which most reduces the unexplained variation remaining in the dependent variable, i.e., the farm population change.

Temporal Associations of Agricultural Components with Farm Population Retention Ratios

A series of multiple regression analyses using component scores of agricultural data as independent variables to explain differences in county farm population retention ratios produced a wide range of findings. In general, farm population changes in the first third of the Twentieth Century were only slightly related to the basic dimensions and nature of agriculture within the northern Appalachians. Later changes in the agricultural population of the northern Appalachians were associated with some major characteristics of the Region's agriculture.

Several possible explanations for this major finding, i.e., the farm population was only recently much affected by the nature of agriculture, are logically possible. Because of the considerable specialization taking place within agriculture, more diversity prevailed in farming activities and operations in the last several decades than in the earlier years of this century. The wide preponderance of self-sufficing farms and general farms in the past, the majority of which had very similar characteristics, precluded most effects that different agricultural establishments would have had on different farm population change rates. In addition, major worldwide disruptive forces, e.g., World War I and its carry over effects into the early 1920s, the Great Depression in the 1930s, and World War II in the 1940s all but submerged any influences that a few varying characteristics of agriculture could have had on the decisions of individuals to stay in or leave farming.

Major Agricultural Attributes Correlated with Ensuing Farm Population Changes

Decades of 1910-1940. The availability of cropland from 1910 to 1930 was more related to farm population changes than any other agricultural characteristic included in this study (Table 32). Nevertheless, the degree of correlation was low. Although there was a decline of farm population during the decades making up this time period, the loss was at a modest rate compared to the more recent decades as illustrated in Chapter III. As such, given the higher birth rates on the farms during the earlier time, there must have been some recognizable pressure upon young men to obtain available farm lands. Land during this time was relatively more important as an input than after World War II when a number of inputs, including fertilizer and higher yielding varieties, made possible greater production on fewer acres. Traditionally, the major means for increasing total production was by expanding the acreage cultivated. As the farms became on the average smaller, e.g., from 1920 to 1925 the average size of farm declined in nearly every county of Pennsylvania, some farm persons had to live at a lower standard of living. There occurred also an increase in the number of farms in most counties of central and western Pennsylvania, while at the same time the number of acres in farms declined in nearly all Pennsylvania counties (see Census of Agriculture for Pennsylvania). Although there had been

Table 32.--Correlation Matrices for Selected Agricultural Components and Farm Population Retention Rates, 1909-1930.

	1909 to 1910 agricultural components with 1910 to 1920 farm population change				
Retention rate	1.00	.13	-.17	.39	.05
Investment	.13	1.00	-.01	-.00	-.00
Livestock and dairy farming	-.17	-.01	1.00	.00	.00
Cropland availability	.39	-.00	.00	1.00	-.00
Component 4	.05	-.00	.00	-.00	1.00
	1909-10 agricultural components with 1910-30 farm population change				
Retention rate	1.00	.19	-.22	.36	.22
Investment	.19	1.00	-.01	-.00	-.00
Livestock and dairy farming	-.22	-.01	1.00	.00	.00
Cropland availability	.36	-.00	.00	1.00	-.00
Component 4	.22	-.00	.00	-.00	1.00

some abandonment of agricultural land within the Region prior to 1910 (Hoglund, 1953; Vaughan, 1929), acres given up in the first decades of this century were usually quite marginal for agriculture. Thus, where additional cropland could be obtained, such areas tended to hold upon the land a relatively greater number of the farm folk.

In both 1910-1920 and 1910-1930, livestock and dairy farming, the second most important component of agriculture within the Region had a low and negative relationship with farm population change (Table 32). The greater the presence of this component within an area, the greater the chance that more loss of farm individuals would occur than in the Region as a whole.

During the early decades of this century, the cumulative relationships of the agricultural components to the total variation of the population changes were low. Although a wide choice of agricultural variables were selected and utilized in the analysis, including measures of technology, labor, fuel, investment, productivity, type, and physical size of farms, the quality of data was undoubtedly not as good as the data of later decades. In addition, not all variables placed in the analysis to represent the agricultural situation in the later decades were available for the 1909-1910 year. Also, 1910 farm population had to be estimated. Consequently, not as a complete view of agriculture was feasible in the earlier decades as at mid-century. Possibly if a more complete and accurate portrayal of agriculture had been obtainable, agricultural characteristics would have been more related to farm population changes.

Although a major hypothesis of this study stated that generally increasing acceptance of new technology forces more persons off the farms, the investment component containing a summation of various investment variables--regarded as representations of new technology--was generally the most poorly associated with the agricultural population changes from 1910-1940 (Table 32), and gave also generally the least amount of explanation to the total variation found within the dependent variable. Investment had however for the period of 1909-1910 been selected by the principal components analysis as the aspect most accounting for the variations within agriculture (Table 12). During this period the use of capital was of much less importance relative to other major inputs than it was later to be and this fact may help to explain its poor performance in accounting for population losses from the farms.

To be remembered also was the amount of capital tied to the use of draft animals, particularly horses, whose numbers really did not decline significantly in the study area until after World War II; thus, the general nature of technology remained primarily unchanged.

<u>The 1950 decade</u>. Contrary to the rather meager correlations of agricultural components with farm depopulation in the 1910 to 1930 era, a high degree of correlation, r = .854, was found between the first component, <u>dairying and off-farm work dichotomy</u> of 1949-1950 and agricultural population change of 1950-1960. Although labor oriented agriculture and <u>residential farming</u> (Table 14) were only slightly but inversely associated with farm population retention

(Table 33), both added to the above and to the stepwise multiple regression analysis resulted in an R^2 of .826.

Table 33.--Correlation Matrix for Selected Agricultural Components, 1949-50 and Farm Population Retention Rates, 1950-1960.

Retention rates	1.00	.85	.01	-.26	0.17	-.02
Dairying and off-farm work dichotomy ratio	.85	1.00	-.00	-.00	-.00	.00
Capital intensive agriculture	.01	-.00	1.00	-.00	.00	.00
Labor oriented agriculture	-.26	-.00	-.00	1.00	-.00	.00
Residential farming	-.17	-.00	.00	.00	1.00	-.00
Extensive farming	-.02	.00	.00	.00	-.00	1.00

Some general agricultural characteristics can be connected to farm depopulation through some inferences made from the above statistical analysis of the 1950-1960 decade. A large part of the Region was agriculturally typed as dairy and where this was true, off-farm work was less than in other areas. As the intensity of dairying increased, work by farmers off the farm decreased and farmers remained in farming much more than did farmers in general. Studies have indicated that off-the-farm work by agriculturalists has led many farm people away from farming (Hathaway and Waldo, 1964, p. 45; Hathaway and Perkins, 1968, pp. 185-189) and the findings of this study support this contention. During the 1950-1960 time period the more dairying in an area the less was the loss of farm population, but in contrast where dairying was of little importance and off-the-farm work was high, farm depopulation ordinarily was significant. Comparison of the farm population change map (Figure 9) and the agricultural component map (Figure 21) revealed that the dairy counties of eastern and northern areas best retained farm persons; whereas, the counties of high off farm employment in western Pennsylvania had high depopulation.

Other than the high association of work off the farm with decreases in the farm population there appeared to have been a number of minor influences or factors contributing to the loss of farm people during the 1950-1960 decade. This observation is supported by the components that had low negative correlations with retention of farm population (Table 33). Interestingly, the expected adverse effects of relative proximity of a farm population to an urban area upon the retention of the agricultural population was found in a study not to hold during the last two decades in the Northeast where the highest off-farm mobility rates for employment were found in the counties most distant from a SMSA (Hathaway et al., 1968, p. 188). Thus, during this period of off-the-farm employment opportunities, especially near cities, may have tended generally to keep farmers in farming somewhat longer in the northern Appalachians than if few "outside" opportunities had existed, although such work eventually led to many leaving farming. This writer found, for 1945-1959 in Pennsylvania, in a study of agricultural land abandonment, a phenomenon closely associated to farm depopulation, that off-farm employment with an r of -.77 gave the most explanation and that rural isolation accounted for some of the agricultural land abandonment (Slocum, 1969, pp. 65-66). Because farm depopulation and agricultural land abandonment are similar, understanding of one could perhaps aid in exploring the nature of the other. Inferential evidence however generally suggests tha- the conditional or push forces were more important in accounting for the very large decrease in the Region's farm population during the 1950s decade than the pull forces.

Again the indice of agricultural investment, formally called intensive agriculture, had no relationship with either the retention or loss of farm population. Increases in the amount of capital invested in a farm did not permit more persons to work on the farm nor did the relative decline in the amount of capital on the farm decrease the number of farm persons. In the former instance, many farmers expanded the scale and size of their enterprise(s) by using more capital, but often did not hire any more workers. Also, as capital could be substituted in many situations for labor, there was less obvious need for a farm couple to have a large family to provide labor on the farm, when the size of the farming operation was expanded. In the second instance, stage of life of the farmer or the family cycle however often influenced his use of capital (Bennett, 1969, pp. 228-230). The median age of farm operators rose in recent years (Nikolitch, 1967). Older farmers, many of whom had grown families, did not experience the necessity of expanding their farming operations so as to better provide for and support their family. Older farmers in general desire to "slow down" and are less interested in having a large and efficient operation as their own health and physical conditions decline with the advancement of age. As the competition from larger commercial farms increased, small scale farmers found that the prices and earnings of agricultural products remained depressed and/or stabilized and tended to give a marginal existence that some farmers, particularly the older ones, improved upon and adjusted to through disinvestment. Cattle were generally sold off. Perhaps, a second tractor was sold. Possibly several house lots were surveyed and disposed of with varying degrees of compensation. Maintenance of buildings often were relinquished. Other examples could be cited. Much of the capital orientation of agriculture came following World War II and took a number of years to reach a high level of intensity; therefore, the effects of these inputs in the full decade after the 1940s upon the demographic component of the general agricultural system had not had enough time to have an impact. The adverse effects that capital and technological inputs have on the endurance and the persistence of the numbers of farm persons accumulate gradually and are stretched out over a relatively long time.

Net Status of Agricultural Attributes Correlated with Preceding Farm Population Changes

The conditions of agriculture at the end of a decade were thought to be possibly better representations of the general trend of the agricultural changes occurring during the same period that the farm population was declining than the conditions at the start of that time. The relationships found in this part of the analysis would represent the more concurrent effects of agricultural changes upon agricultural population changes. As technological effects have been assumed to take a relatively long time to affect the population numbers, as concluded in the above analysis, no important correlation of the agricultural component representing the input of technology was expected with farm population change, but correlations with the other components were thought likely.

The 1920s decade. During this decade of an expanding economy and off the farm opportunities, changes in agriculture could be expected to explain a very small proportion of the total decrease in the farm population. Nevertheless, self-sufficing farms and dairy farm systems (Table 13) were negatively related to the preservation of the farm people (Table 34). These two types of farming contributed statistically about 14 percent to the total possible explanation. In contrast intensive agriculture had some influence on keeping people in agriculture, possibly because during this decade average size of farms and the amount of land in farms decreased in many of the counties, and through this type of farming, persons were able to continue in agriculture.

Table 34.--Correlation Matrix for Selected Agricultural Components, 1929-30 and Farm Population Retention Rates, 1920-1930.

Retention rates	1.00	.23	-.20	-.32	-.01
Intensive agriculture	.23	1.00	-.02	.00	.00
Dairying	-.20	0.02	1.00	-.00	-.00
Self-sufficing farming	-.32	.00	-.00	1.00	-.00
Part-time farming	-.01	.00	-.00	-.00	1.00

The 1940s decade. Dairy farming in contrast to earlier decades had a positive effect on retaining farm population and was associated more with population change than any other agricultural system or attribute (Tables 14 and 35). Truck farming and/or specialty crop systems perhaps were associated with losses of agricultural population because of their intensive characteristics and demand for labor which, because of the War, was scarce. As labor availability problems existed in agriculture, there apparently was some return to more extensive farming which helped to retain the population engaged in it.

Table 35.--Correlation Matrix for Selected Agricultural Components, 1949-50 and Farm Population Retention Rates, 1940-1950.

Retention rates	1.00	.39	-.07	-.24	.05	.24
Dairy and off-farm work dichotomy ratio	.39	1.00	-.00	-.00	-.00	.00
Capital intensive agriculture	-.07	-.00	1.00	-.00	-.00	.00
Labor oriented agriculture	-.24	-.00	-.00	1.00	-.00	.00
Residential farming	.05	-.00	.00	-.00	1.00	-.00
Extensive farming	.24	.00	.00	.00	-.00	1.00

The 1950s decade. With 1970 components of agriculture as independent variables a multiple correlation (R) equaling 0.785 with the farm population change of the 1950s appeared. The characteristics of 1950 agriculture retained in 1970 agriculture were closely connected to the changes in the numbers of persons on farms during the 1950s. Interestingly, dairy farming without work off the farm accounted for a large part of the relative retention of population within agriculture (Tables 19 and 36). The other agricultural components selected by the stepwise regression all worked against the retention of agricultural labor or encouraged farm depopulation. The selection of a technological summary indice, mechanization and motorization, with an explanation of nearly 9 percent of the total variation found within the agricultural population change data was the first indication of support for the basic technological-related hypothesis in this study. Technology seemingly has had a small negative effect nearly coinciding with population change upon the short term maintenance of the farm population, but apparently these effects are not readily measured in a direct sense. Heavy reliance on capital representative variables as indices of technological developments probably was not sufficient to give indicators of separate

Table 36.--Correlation Matrix for Selected Agricultural Components, 1969-70 and Farm Population Retention Rates, 1950-1960.

Retention rates	1.00	.70	.02	-.13	0.15	-.09	-.29
Dairying and off-farm work dichotomy ratio	.70	1.00	-.02	.00	-.00	-.00	-.00
Capital intensive agriculture	.02	-.02	1.00	-.00	.00	-.00	.00
Labor oriented agriculture	-.13	.00	-.00	1.00	-.00	-.00	.00
Residential farming	-.15	-.00	.00	-.00	1.00	-.00	-.00
Corn Belt agriculture	-.09	-.00	-.00	-.00	-.00	1.00	-.03
Mechanization and motorization	-.29	-.00	.00	.00	-.00	-.03	1.00

and entire technical influences. For example real estate values have often reflected the proximity of an area to a city, and evaluation of the property has been based upon its potential worth for urban residential, industrial, and/or commercial land uses. These higher values are weakly related to actual improvements made on the lands and buildings. The two additional agricultural farming systems, residential farming and labor oriented agriculture, had only low correlations of a negative nature, with farm depopulation. Because of the human resources demanded for World War II, labor scarcity was troublesome on into the 1970s. Other new developments arose, including residential farming, some of which, because of the newness of the interest, presumably resulted in disillusionment on the part of some new arrivals on to farms who stayed for only a short time.

The 1960s decade. Agriculture in the northern Appalachians appears according to the principal components analysis to have become more heterogeneous recently as more components were extracted from the agricultural data than for the earlier decades. A stepwise regression analysis indicated that nearly all of these basic aspects of agriculture were either related partially to farm population retention or decline (Tables 19 and 37). A multiple correlation R = 0.733, suggests that in contemporary times the increasingly varied nature and most important characteristics of agriculture are increasingly related to the growth or decline of agricultural population numbers. As in the 1950s, during the 1960s those areas with much dairying and little off the farm employment tended to keep farmers on

Table 37.--Correlation Matrix for Selected Agricultural Components, 1969-70 and Farm Population Retention Rates, 1960-1970.

Retention Rates	1.00	.38	.34	-.37	-.29	-.23	.05
Dairying and Off Farm Work Dichotomy	.38	1.00	-.02	.00	-.00	-.00	-.00
Capital Intensive Agriculture	.34	-.02	1.00	-.00	.00	-.00	.00
Labor Oriented Agriculture	-.37	.00	-.00	1.00	-.00	-.00	.00
Residential Farming	-.29	-.00	.00	-.00	1.00	-.00	-.00
Corn Belt Agriculture	-.23	.00	-.00	-.00	-.00	1.00	-.03
Mechanization and Motorization	.05	-.00	.00	.00	-.00	-.03	1.00

the land but much less so, however; the dairy farming and the off farm work dichotomy component explained more of the variation in the farm population change than any other agricultural variable, $R^2 = 0.146$. The second most important agricultural variable associated with population changes on the farms was labor oriented agriculture. Those enterprises using comparatively more labor than other types of agriculture especially lost persons employed in their operations. This aspect of agriculture nearly equaled the most important agricultural variable for power of explanation and gave the most important farm-related reason for farm depopulation. Labor continued to be among the most expensive inputs of agriculture and where cheaper substitution could be made, often with an aspect of technology, this often occurred. However, labor received considerably lower wages on the farm than in nonagricultural employments; many such farm employees and owners were thus attracted to nonfarm work. A curious relationship is that between capital intensive agriculture and the relative increase and strength of the retention of persons upon the farms. Possibly during the 1960s, the use of additional capital and technological inputs, especially low cost energy, became important for doing the necessary work for keeping on the farms the residual population that was left after several decades of heavy outmigration. The farmers with savings to invest in their farming operation or with access to capital may have been the farmers who most successfully adjusted to the migration of labor. Those individuals who engaged in residential farming may have only temporarily prevented farms from going out of production as this system of agriculture formed a negative relationship with farm population changes. "Bona fide" farmers sometimes sold to persons who would farm for a short time, and then retire; using the farm as their residence, these persons would rent out the farm land to nearby farmers.

In addition to residential farming and labor oriented agriculture, "corn belt agriculture," a type of agriculture only delineated in the 1960s agricultural data, was associated with agricultural depopulation. Interestingly two labor variables, value of hired labor and labor productivity, along with corn yields, were found earlier in this study to be basic characteristics of this farming system.

Geographical Analysis with Residuals

The residual represents the difference between the dependent variables actual value for each observation, i.e., of a county, and the value estimated by the regression equation. A regression using the independent variables may overpredict an observation's dependent value or underpredict it, producing a negative or positive residual, respectively. Thus, the retention of farm population is overpredicted if the value of the residual from regression is negative and underpredicted if this value is positive. Therefore, the values nearest to zero in certain counties mean that these counties' farm population retentiveness is very nearly explained by the selected independent or explanatory variables. Mapped residuals present an excellent measurement of the effectiveness of a regression model in accounting for areal variation in a phenomenon (Thomas, 1968), which in this study is the proportion of the agricultural population staying on the farm per county from one time to the next selected time.

For some of the time periods studied, the initially selected agricultural component is well correlated to the dependent variable. In these instances, it is thought especially revealing of the relationships of certain types of farming to agricultural population changes to delete all of the components which reduce the unexplained variation, except the one most related to the population variable. Then, the residuals produced for the counties are associated only with the component giving the most explanation, and the areas made up of counties particularly affected by this most influential agricultural component can be determined. The same procedure may be followed with the second most important component in explaining the population changes. Only after some components have proven their worth by accounting for an important proportion of the total variation in a regular and undirected run of the stepwise multiple regression, are they tested individually and the areal distribution of their residuals analyzed. In this manner the areal significance of individual agricultural components in changing agricultural population is discovered.

Comparisons of those counties whose agricultural populations are associated with single components as opposed to a collective number of components, presents a portrayal of areas with perhaps a major cause of farm population change and those areas with multitudinous causes. Once the above areas are recognized, then the patterns of the counties whose retention of agricultural populations or depopulation are <u>unassociated</u> with any of the agricultural components, serve as the basic clues for generating additional hypotheses and for selecting sites for field studies.

The Relative Areas Associations of Farm Population Changes to the Selected Agricultural Components

By mapping the residuals of the multiple regressions and of a few selected linear regressions, basically three different county groups appear--namely those counties whose farm population changes are well accounted for, either by a composite of agricultural components or by an agricultural component, i.e., with values between -4.9 to +4.9 and those two county groups whose farm population changes are significantly "under explained" or "over explained" and which have values of -10.0 and less or +10.0 and over, respectively. Generally, the higher the multiple correlation, the more the number of counties whose values of agricultural population change are explained by the agricultural components. Often the counties with dependent values, i.e., farm population retention or change, closely associated with the independent variable(s) will be contiguous counties as will the group of counties with values most deficiently explained. A cluster of counties so depicted often will have similar agricultural and geographical characteristics; a knowledge of these data may aid in the establishment of new insights in describing and explaining the associations between the dependent and independent variables. In a like manner, the geographical nature of the subareas with farm population changes most inadequately explained by the regression model, may give clues for the establishment of new hypotheses that when tested may provide additional explanations for the farm population changes. Ideally, each county's farm population change should be related to one or more agricultural components or attributes. Those counties with farm population changes unassociated with agricultural developments merit intensive field study.

Areal Relationships of Subsequent Farm Population Changes to Agricultural Components

The areas of explained agricultural population change, 1910-1930. For the 1910-1930 period the agricultural component of cropland availability was the attribute most related to farm population changes, explaining about 13 percent of the farm population varied changes. Two other agricultural attributes, livestock-dairy farming and diversified farming added together accounted for about 10 percent more of the variation in the dependent variable.

What counties had farm population changes closely associated with these agricultural characteristics? The counties best explained by cropland availability and also the additional agricultural characteristics that had residuals between -4.9 and +4.9 were generally located within the central part of the northern Appalachians, except for a few counties in the northwestern area and a set of contiguous counties in the Triple Cities sub-region on New York State (Figure 32). Interestingly, these "explained" farm population change sub-regions correspond with the areas that had average farm population losses from 1910-1930. Consequently, in the counties with average farm population decreases, farm persons had a tendency to stay in farming where there was an adequate supply of agricultural land. Most of the counties with average losses tended to have diversified farming. Possibly where dairying was on the increase, it was replacing some small general farms as dairying required larger acreages (Ellis, 1967, p. 277).

Some counties, e.g., Broome, Erie and Luzerne with large cities such as Binghamton, Erie, Wilkes-Barre, respectively and some adjacent counties had significant decreases in their cropland acreages; however, the most urban counties retained more farm population than would have been predicted by only the presence of potentially useful cropland. Nonurban counties whose farm population changes were reasonably associated with the selected agricultural components had a considerable concentration of farming activities within fertile valleys and/or in general and diversified farming.

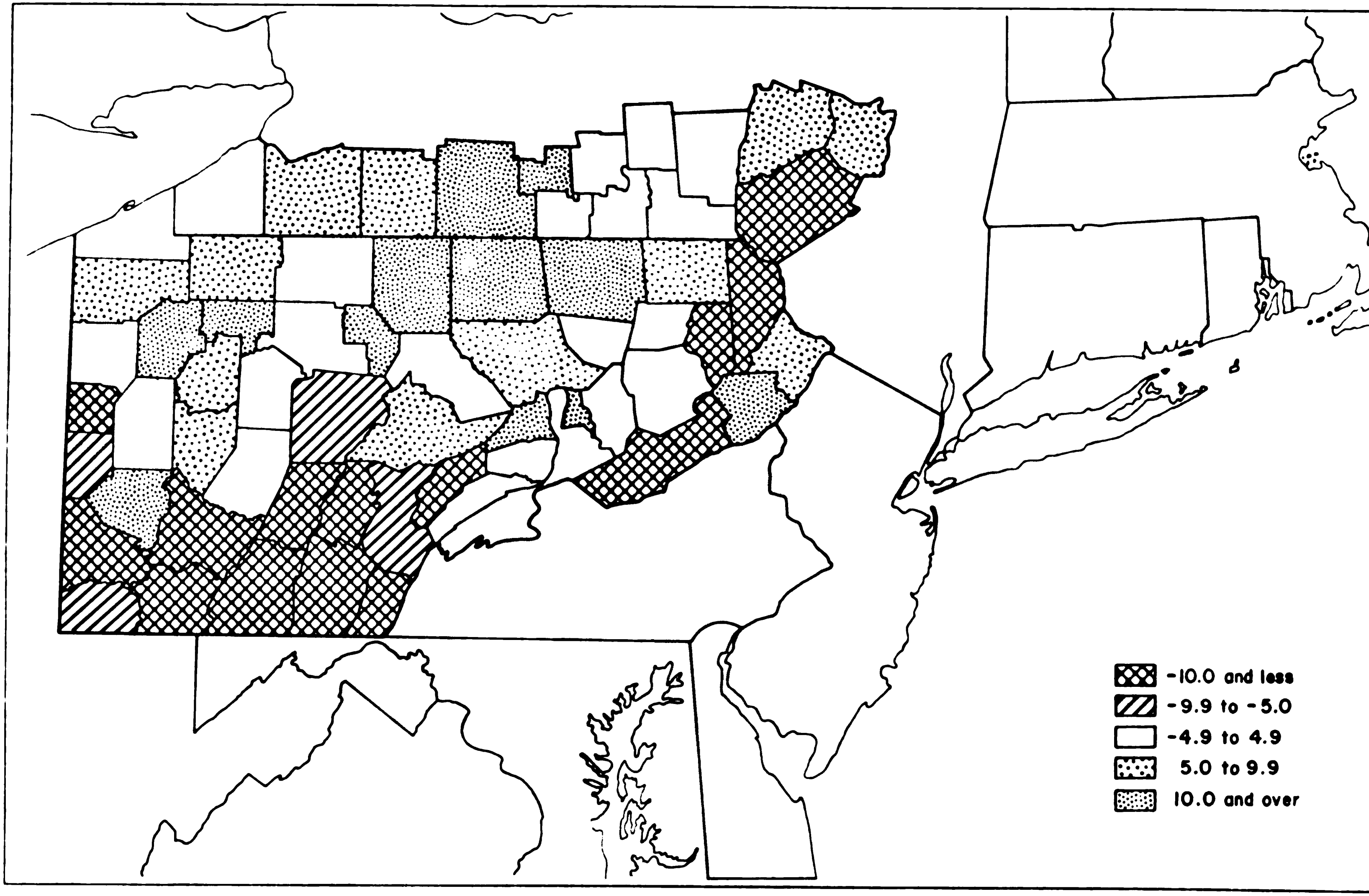

Fig. 32.--Residuals from Regression of Retention Rates of Farm Population, 1910-1930, on Scores of Associated Agricultural Components, 1909-1910.

Areas with high negative residuals, 1910-1930; some hypotheses. What explanations can be given for those areas with unexplained farm population changes? Because the multiple correlation of the composite agricultural components with county farm population change was of only moderate size, i.e., R = .52, it was to be expected that there would be many counties whose population changes on the farms would not be associated with the selected agricultural characteristics. Two such areas existed: one in the north central sub-region and another in the eastern and southern margins of the Region. In the north-central sub-region at the end of two decades, there were far fewer persons left on the farms than would have been predicted by the effects of the agricultural components found to be generally related to the population changes. Some nonagricultural factors were obviously important in lowering the labor force on the labor force on the farms in these counties.

In the north central area of Pennsylvania was located many marginal areas for farming. Much of the land, because of infertile soils and short growing seasons, was unfavorable for economic production. Numerous acres should not have been cleared for agriculture. The area had many townships settled relatively late as did also "the infertile and rugged Pocono Plateau" (Gould, 1969, pp. 46-47; Florin, 1965). The area had less than an hundred years ago a major lumbering industry. The widespread removal of the forest cover subjected the soils to erosion and deprived much of the area from a dependable livelihood from either forestry or farming. Therefore, there were many failing attempts of farmers to farm land which was frequently marginal for commercial agricultural production.

A farmer's increasing efforts commonly result in worsening the erosion problem. "Soil erosion takes place so gradually that most people, including the farmers themselves, are unaware of it." From 1900 to 1931 in Pennsylvania more than 51,000 farms containing at least four million acres were lost to agriculture because of soil erosion. Some areas had upwards to 25 percent of all farms abandoned. By 1930 more than a million additional acres were considered submarginal due to the serious damage of erosion (Stevens, Cordier, and Benjamin, 1953, p. 358). Some areas were naturally affected more than others. The north central counties of Pennsylvania were particularly adversely affected by soil erosion (Patrick, 1938, p. 10).

In addition, some public land policies and decisions determined the availability and use of agricultural land. Pennsylvania at the end of the last century began the purchase of vast acreages of diverse types of land, including tax delinquent parcels, abandoned farms, and cutover forests. The exact proportion of each of these types of lands remains obscure, but most lands appear to have been mostly deforested or nonagricultural. Until about 1870 Pennsylvania was the leading producer of lumber in the U.S.; and seemingly, it was not until after the leading lumber companies had moved out of the State in the late 1800s that the great importance of harvesting locally produced timber was recognized (Stevens et al., 1953, pp. 349-353). The State was then regarded as the only organization large enough to own and manage forest lands and to promote the conservation and reforestation programs.

Most of these new public lands became State Forest, State Game Lands, and/or State Parks. The north central sub-region, the largest area of significant farm population decreases from 1910 to 1930, had in the first decade of the 1900s at least one half of the approximately half a million acres owned by Pennsylvania (Pa. Dept. of Forestry, 1902, pp. 11-25). The acquisition of forests and potential forest land for public control was ongoing for many years, partly because of farm abandonment. All the lands at first were designated as "reservation lands" and no formal division existed; however, given the general location of these lands in much of the roughest terrain of the State, most of the acreage became State Forests. Nevertheless, it is interesting to note, that the areal pattern in the State lands was established in the beginning; nearly all of the lands purchased by the public were situated in the central third of the State, coinciding with the highlands and the ridge and valley section of the State. The major exception to the location of these lands was the Commonwealth's purchase of lands in the Pocono Highlands area of Pike, Monroe, and Lackawanna counties; and New York State established a forestry preserve in the Catskill uplands, a part included in the extreme northeastern counties of the northern Appalachians (Ellis, 1967, pp. 504-505).

Possibly, the public ownership of lands deprived some of the area's agricultural population of supplemental earnings from the land, resulting in some financial difficulties for farmers. Of importance was the interdependence of some farms and the lumbering industry. Local agriculture supplied the forestry workers with food stuffs and other services. Farmers raised horses, oxen, and mules; sheltered the draft animals in the nonlumbering periods; and provided the hay and some of the grains to the woodsmen's animals. Once lumbering folded, the local markets contracted. Insufficient transportation and the marginal nature of farming within the sub-region prevented successful participation in the national market.

Agricultural activities and agricultural systems, before the development of widescale transportation facilities and refrigeration, were an integrated part of the overall rural system and owed their existence especially in the areas of least favorable physical conditions to the presence of other well-known rural economic activities, such as forestry, mining, and additional mineral resource workings. As to the latter, an interesting question is the effect that the oil discoveries must have had on agriculture in western Pennsylvania. Agriculture in the more physically unfavorable areas, where forestry and mining prevailed, existed often to provision the woodsmen and miners. Note has often been made of the countless men attracted to the American West by gold discoveries who found the raising and producing of crops and agricultural products for the local mining population more lucrative than mining.

Few words appear to have been written on the importance that rural primary economic activities have had on the existence of agricultural systems in the eastern United States. As Pennsylvania had historically a strong forestry and mining economy, the above discussed influence greatly affected the nature and longevity of farming in some of those areas particularly characterized by such rural primary economic activities. When these basic industries declined farming after some lag in time did also, particularly after the passing of the older generations whose persons were often "trapped" in farming as they were often too old and/or without skills to qualify for other occupations.

Areas with high positive residuals, 1910-1930; some hypotheses. According to the map of residuals for the period 1910 to 1930, southwestern Pennsylvania with the exception of Allegheny County, retained considerably more of its agricultural population than predicted by the agricultural components, e.g., cropland availability, dairy farming, etc. (Figure 32). This sub-regions farming possibly was not well defined by the agricultural primary data and the agricultural components of 1910. The agricultural characteristics varied in importance from county to county within the area; suggesting that generalization on agriculture for this subdivision of the northern Appalachians was unrewarding.

There was a higher retention of the farm population in southwestern Pennsylvania and in the anthracite area than any other parts of the Region, e.g., the counties of Lackawanna, Luzerne, Carbon, Schuylkill, and Northumberland (Figure 7). In 1930 most of these coal counties had large farm populations compared to other counties and also, large urban populations. Because of the more locally focused economies at this time compared to those that were to follow, the farm population found readily available markets for their farm products and services in the heavily populated mining communities.

As in the earlier positive hypothesized association of forestry's successful development and decline with the respective fortunes of farming, a very similar postulate can be stated for the overall relationship between mining and farming before the advent of modern mechanization and techniques which greatly reduced total employment in mining. Farming apparently benefitted as long as coal production increased, was labor intensive, and the mine population expanded. World War I boosted the mining economy of Pennsylvania and it remained relatively healthy until after 1930 when Pennsylvania lost its leadership in soft coal production (Stevens, 1964, p. 348). Coal mining however saw some omens during the 1920s. The number of miners employed in coal mining and the price of coal declined. Agricultural prices decreased also, but where farms were more accessible to markets, as in southwestern Pennsylvania, agriculture became more diversified, and agricultural income stabilized. Although mining jobs declined, "unemployment in mining areas usually entailed fewer working days rather than a complete discharge, which kept miners from looking for jobs elsewhere" (Klein and Hoogenboom, 1973, pp. 396-397). In addition, the declines in mining late in the 1910-1930 period had only negligible effects on the agricultural population as sufficient time had not passed for the reactions in agriculture to be noticeable. The map of residuals revealed for both hard coal counties of northeastern and soft coal counties of southwestern

Pennsylvania that the farm population stayed much more than would have been expected with the agricultural characteristics present.

<u>The areas of explained agricultural population change, 1950 to 1960</u>. The variation in the county population retention ratios was highly accounted for, during the 1950s by agricultural characteristics; the dairying and off farm work dichotomy component of agriculture alone formed an r of .854 and statistically accounted for nearly 73 percent of the total variation found in the farm population change values. With the inclusion of truck and/or crop specialty farming, plus residential farming R equaled .909 and the amount of the total variation explained by agricultural components rose to nearly 83 percent.

With the above pertinent agricultural components acting in concert, two-thirds of the counties of the northern Appalachians had residual values near to zero (Figure 33). These counties formed an areal pattern that took in two quite different agricultural areas: (1) the main dairy counties of the eastern half of New York's Southern Tier and of the far northern counties of Pennsylvania, and (2) the counties of western Pennsylvania where prevailed an agricultural economy characterized by working off the farm. In the dairying area the low rates of farm depopulation in the 1950s was much associated with the significant tendency then for dairymen families to stay on their farms, to shun off farm employment, and to devote full time to the pursuance of a successful dairy operation. The major exodus of dairy farmers and their families was to occur a decade later. A major contrast existed between the relatively low rates of population

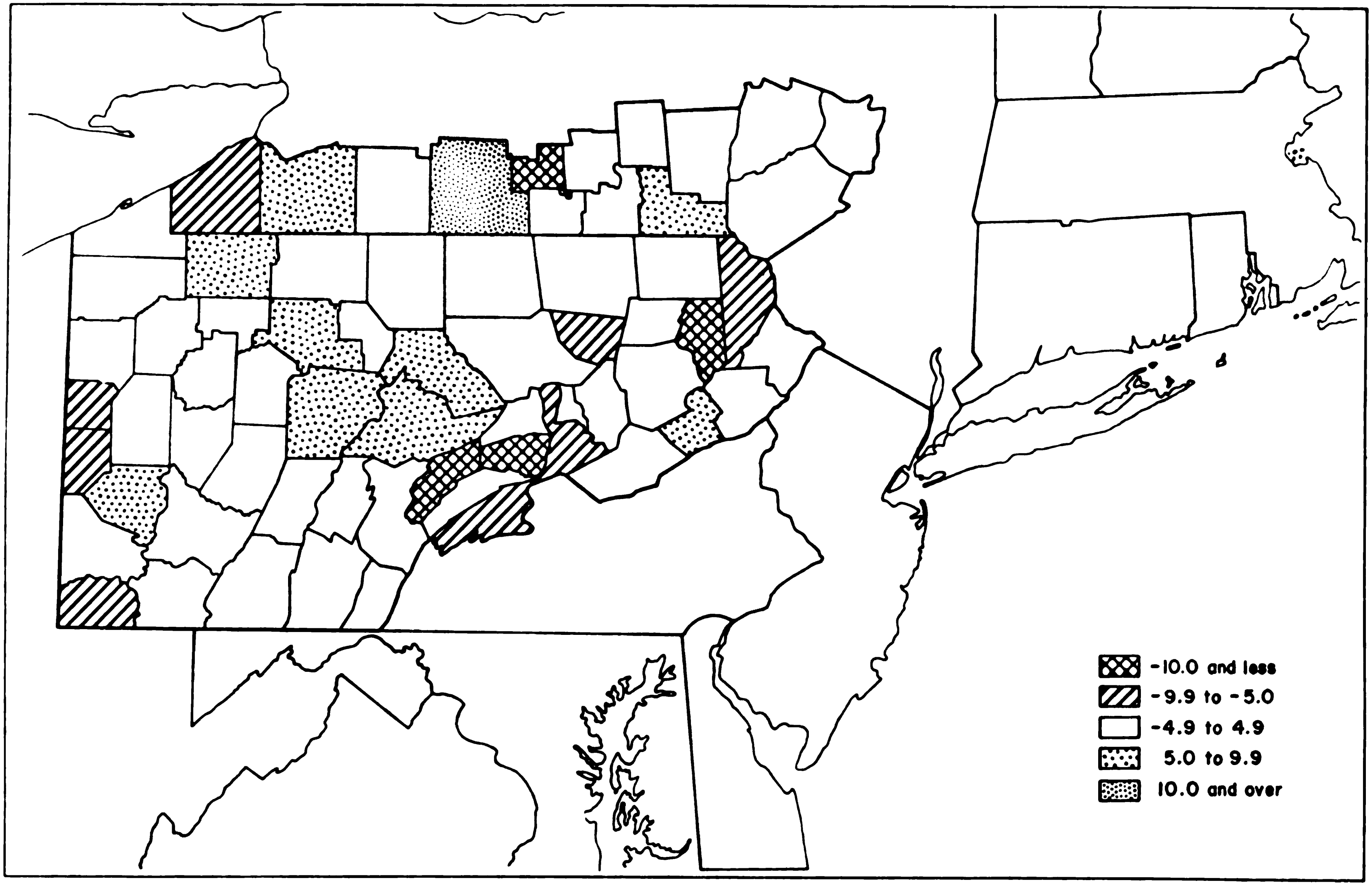

Fig. 33.--Residuals from Regression of Retention Rates of Farm Population, 1950-1960, on Scores of Associated Agricultural Components, 1949-1950.

losses from the farms in most of the eastern portions of the northern Appalachians and the major losses in the agricultural population of western Pennsylvania (Figure 9) where part-time farming was much in vogue (Figure 34). Overall these two quite different farm population change areas during the 1950s were closely related to the relative importance of dairying.

Some counties farm population changes were related to dairying, but not collectively to all the agricultural components chosen by multiple stepwise regression program (Figure 35). The counties of Centre, Clearfield, Clinton, and Juniata in central Pennsylvania and the counties of Lackawanna and Wayne in northeastern Pennsylvania had population changes primarily related to dairying or off the farm employment. Additional counties so explained were Beaver and Warren. Nevertheless, the map of the dairying or the off the farm work residuals contained basically the same areal patterns as did the map of multiple residuals.

The mapped residuals of labor oriented farming revealed some clear areal patterns (Figure 36). Much of the Allegheny Plateau of western Pennsylvania, an area where extensive farming practices have had much use, had farm population declines that were much larger than of course could be explained by labor intensive types of farming that were areally limited. Central Pennsylvania with its special crops and higher labor needs contrastingly retained more of its agricultural population than would have been expected. The northeastern part of the Region appeared as an area with relatively low losses of farm people because of its strong orientation to dairying. Likewise,

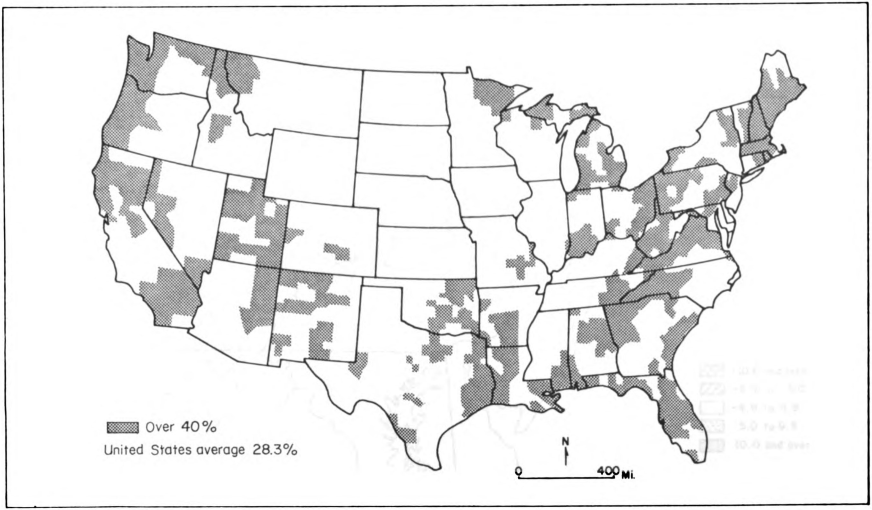

Fig. 34.--Percent of All Farm Operators Working 100 or More Days Off Their Farms, 1954.

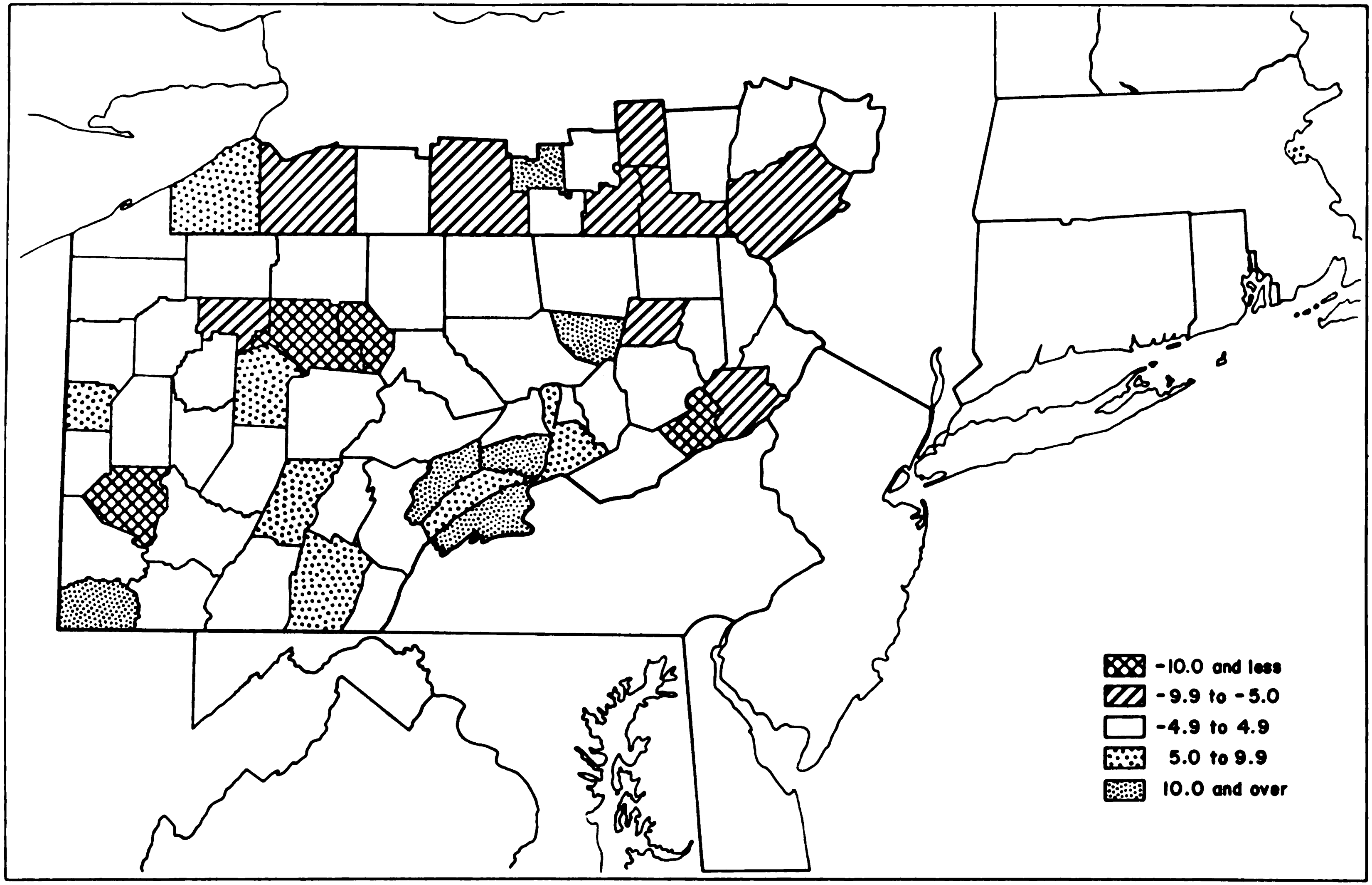

Fig. 35.--Residuals from Regression of Retention Rates of Farm Population, 1950-60, on Scores of Dairying-Off Farm Work Ratio, 1949-50.

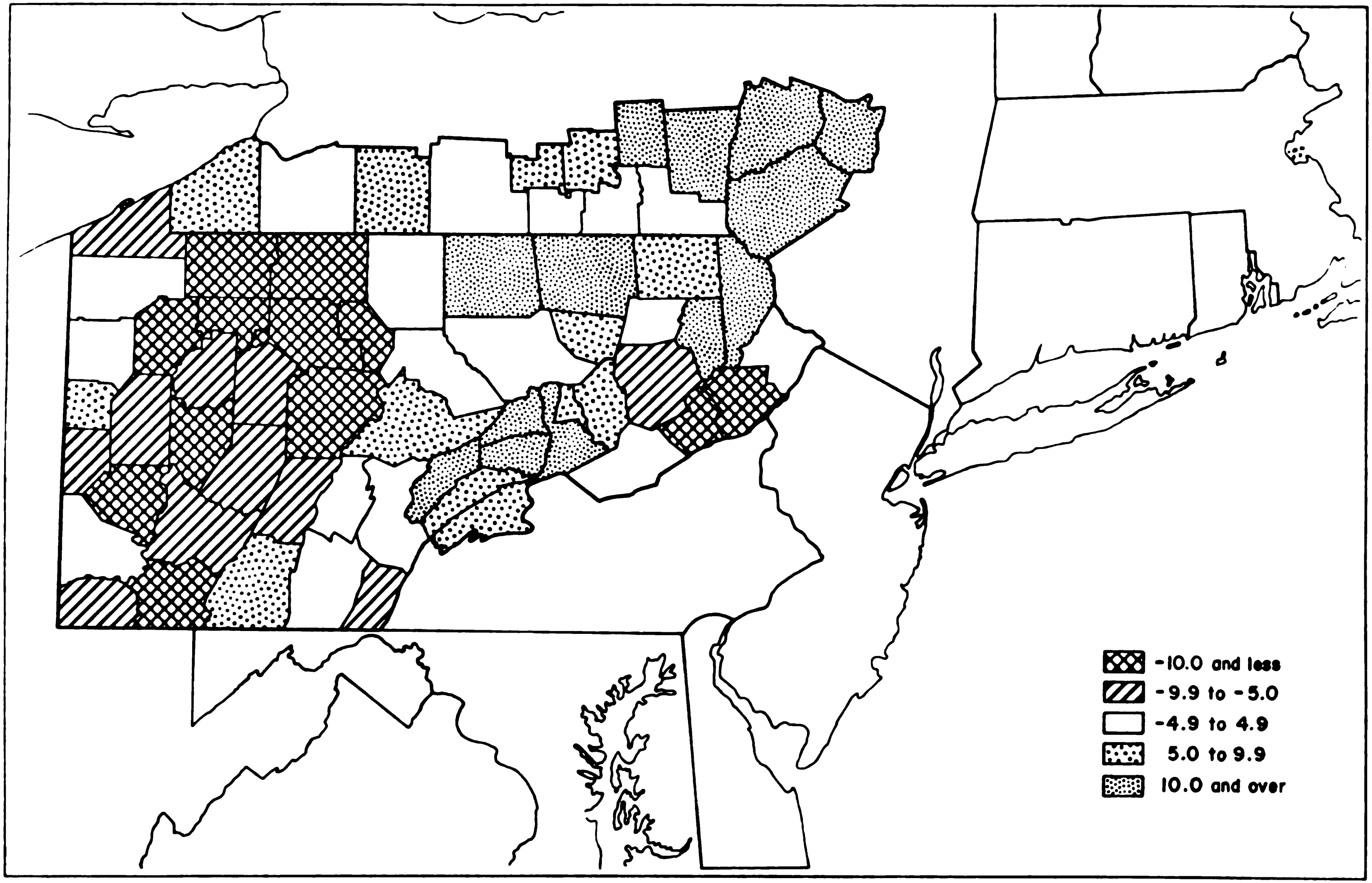

Fig. 36.--Residuals from Regression of Retention Rates of Farm Population, 1950-60, on Scores of Labor Oriented Agriculture, 1949-1950.

several counties of northeastern Pennsylvania with a strong dairying orientation had low farm depopulation. The relationship of the labor component to truck farming or specialty crop farming helped explain the population changes in some southern tier counties of New York State. The counties particularly affected were: Broome, Cattaraugus, and Steuben. The farm population changes of several counties in Pennsylvania were importantly related to this agricultural component which added to the multiple relationship in primarily the north-central, south-central, and the Pennsylvanian western boundary areas of the Region.

Occasionally the combined components in the multiple regression seemingly worked against each other for some counties. Although one component could be related to the farm population change when additional components were added a residual from multiple regression for some counties was produced which did not exemplify an important total explanation.

Areas with high negative residuals, 1950-1960; some hypotheses. The counties with the lowest residuals from the multiple regression included several counties of north-central Pennsylvania and several scattered counties. Steuben County in New York State had the lowest score; however, this was presumably related to the importance of grain farming there as was that of north-central Pennsylvania in part, especially in Centre and Clinton counties. North-central Pennsylvania probably lost more of the farm population than predicted by the multiple regression because some subsistence farms and marginal farms had been retained longer due to the area's isolation than in some other parts of the Region. Three of the remaining counties, Broome, Allegheny, and Carbon were under the influence of significant urbanization. Cattaraugus County with a moderately negative score had agricultural characteristics that associated much of the northern part of the County with the intensive dairying-grain growing agriculture of western New York and most of the southern part of the County with the more extensive type of agriculture of the Allegheny province of Pennsylvania. Dairying with much of the required grain grown on the farms as in western New York State was not especially associated to farm population changes as revealed by the mapped linear residuals of the dairying and off the farm work component (Figure 35). Like southern Cattaraugus County most of Warren County, although its farm population change was illustrated by the mapped linear residuals to be associated with the most important and first selected component, presumably had some agriculture closely related to the extensive and subsistence kind found in the north-central counties of Pennsylvania.

Areas with high positive residuals, 1950 to 1960; some hypotheses. Only a few counties had relatively high positive residuals. Some of these counties had a major type of agriculture rather unrepresented by the agricultural data included in the multiple regression program. Both Chautauqua and Schuyler counties in New York had an important grape and fruit production. Greene County in Pennsylvania raised sheep. Sullivan County was rather atypical of the Region's general agriculture because of the low level of economic and rural development (Gamble, 1967). As stated above some of the counties had population changes related to the dairying and off-the-farm employment component when its effects were considered separately; thus, the counties with high multiple residuals, e.g., Lackawanna, Wayne, and Beaver, were accounted for. Lastly, a number of counties in the central portion of Pennsylvania, Mifflin, Snyder, Perry, and Northumberland, found within the Ridge and Valley physiographic province, had farm population changes unexplained by any statistical measure of agriculture. Probably, the agricultural activities and beliefs of the Amish and Mennonites in this subregion of the State tended to keep the relatively high proportions of persons in agriculture on the farms during the period.

Areal Relationships of Preceding Farm Population Changes to Agricultural Components

The analysis of residuals discussed below sought in part to discover whether measurements of agriculture at the end of and following a period of farm population change could explain the relative retention of persons in agriculture.

The areas of explained agricultural population change, 1940 to 1950. During the years of the 1940s, agricultural populations were greatly affected by World War II; nevertheless, there were as a consequence some secondary effects. A significant demand for labor attracted persons away from the farms and farm persons joined the armed forces, forcing an increase in the rate of capital input substitution and mechanization. Labor intensive types of agriculture lost workers; whereas, extensive farming types of farming and dairying tended to retain persons on farms more than did agriculture in general.

Support for the above observations were given in the comparison of the residuals produced from the multiple regression of the selected 1950 agricultural components and the county farm population changes (Figures 37 and 38). Except for the northwestern part of the northern Appalachians and the western half of the New York southern tier, counties with the least losses in farm population had residuals close to zero; and therefore, had the farm population changes most related to the agricultural components. These counties were primarily located in the major dairying areas of southeastern New York; northeastern, central, and northwestern Pennsylvania. Dairying held agricultural population on the farms the best of any agricultural attribute and accounted for the majority of the farm population changes associated with farming characteristics.

The areas of unexplained agricultural population change, 1940 to 1950. The counties with high negative residuals had in common the highest rates of farm depopulation which were minimally associated with the chosen agricultural components (Figures 8 and 37). Most of the areas so depicted had physical conditions unfavorable to agriculture, i.e., associated with the Pocono Plateau and the Allegheny Highlands. In addition, several of the counties, particularly those of the Pittsburgh, Scranton, and Binghamton metropolitan areas were represented by high negative residuals. Only a few counties, Allegheny County and the counties of northeastern Pennsylvania had the highest rates of farm labor utilization; however, this agricultural characteristic could not explain an important proportion of the large farm

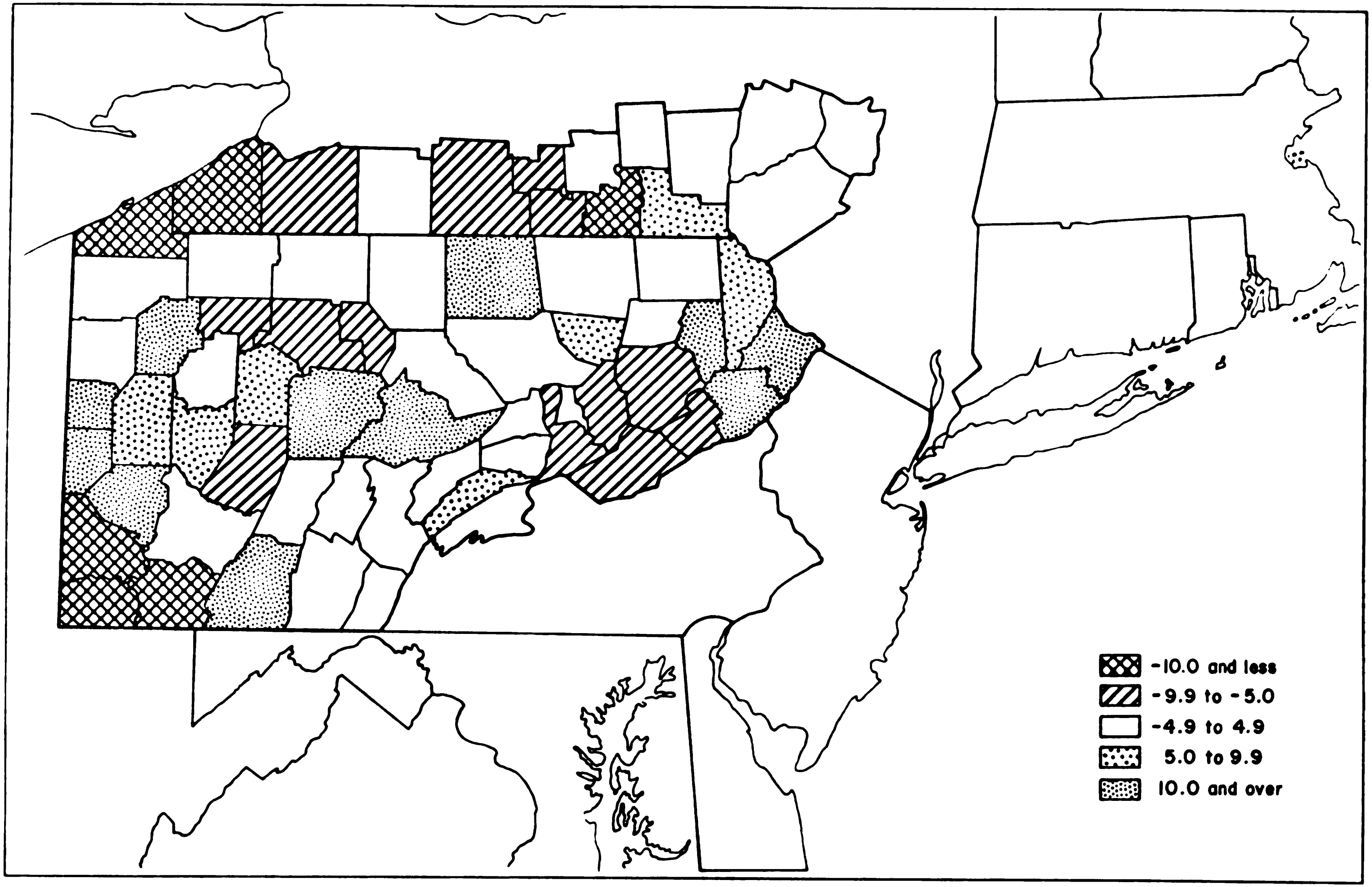

Fig. 37.--Residuals from Regression of Retention Rates of Farm Population, 1940-1950, on Scores of Associated Agricultural Components, 1949-1950.

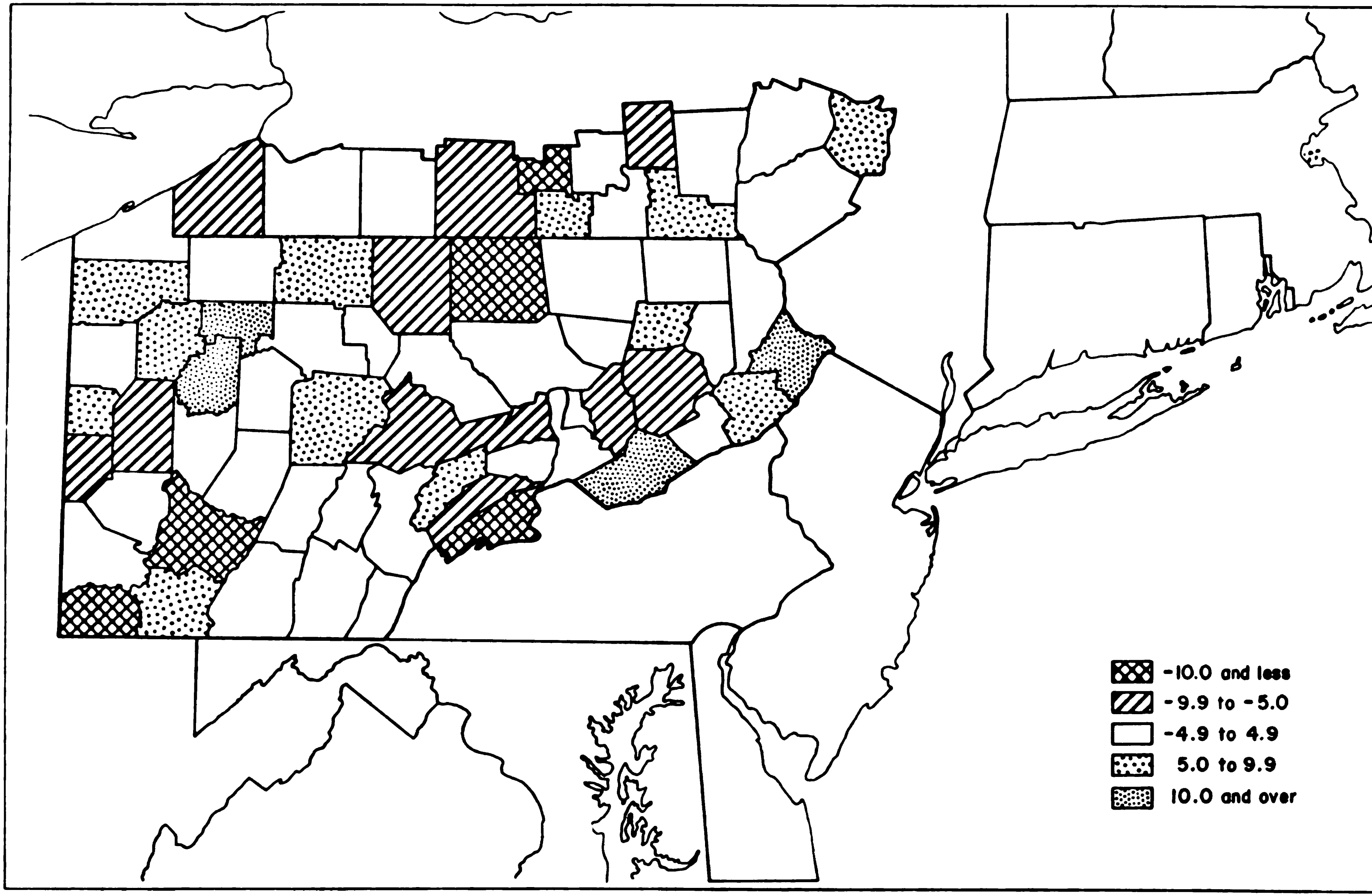

Fig. 38.--Residuals from Regression of Retention Rates of Farm Population, 1960-1970, on Scores of Associated Agricultural Components, 1969-1970.

population declines of those counties during the 1940s, possibly because of the demands of industrial production during World War II.

Some of the low agricultural depopulation rates of counties were associated with dairying according to the above areal analysis of the near zero residuals. Nearly all the remaining counties with low depopulation of farms had moderately high and high positive residuals. Southwestern, east-central and parts of northwestern Pennsylvania, and the western counties of New York's southern tier retained more persons in agriculture than predicted by the stepwise multiple regression, possibly because farming in these areas had large economic and productivity growth rates and possessed types of farming unrepresented by the agricultural components. Except for Forest, Elk, and Cameron counties in northwestern Pennsylvania the areas had numerous small cities and towns that provided an increasing local demand for farm products and supplemental employment.

The areas of explained agricultural population change, 1960 to 1970. The decreases in the farm population within the northern Appalachians from 1960 to 1970 were associated with the overall nature of agriculture of the Region in 1970; the coefficient of multiple correlation (R) equaled .733. More attributes of farming were related to farm depopulation than during any other period analyzed in this study. Farm persons engaged in dairying and capital intensive agriculture were less inclined to leave farming than farm individuals who worked off the farm, labored intensively in some types of farming, used their farms primarily as a residence, or adopted a type of agriculture emphasizing high unit production such as "corn-belt agriculture." The adoption of types of farming with a high production emphasis may have at times overtaxed a farmers financial resources.

The counties with moderate farm population declines generally coincided with the counties with near zero residuals. Areas of average agricultural population changes well explained were the dairy counties of northeastern and southcentral Pennsylvania and the eastern part of the southern tier of New York (Figures 10 and 38). A number of central Pennsylvania counties with strong measures of capital intensive agriculture but with only average dairy scores had moderate agricultural depopulation and residuals near zero. Apparently either the predominance of dairying or capital-intensive agriculture was associated with average farm population change rates (Figures 25, 26 and 10). A comparison of the linear residuals of the dairy off the farm work and the capital intensive agricultural residuals revealed that the moderate population losses of the eastern part of the northern Appalachians were associated with dairying; whereas, the average losses in counties of western Pennsylvania were related to both the dairying or off the farm work component and capital intensive agriculture.

Counties with high population loss rates that associated with the composite of agricultural components were Allegany, Delaware, Tioga, and Tompkins in New York State; and Allegheny, Armstrong, Bedford, Cameron, Carbon, Elk, Fulton, Jefferson, Lycoming, Northumberland, and Washington in Pennsylvania. Cameron, Carbon, Elk, Fulton, and Allegheny counties, often among the anomalies in studies of Pennsylvania, had unexpected explanations for farm depopulation.

The areas of unexplained agricultural population change, 1960 to 1970. There was a rather close correspondence between the counties with the largest farm depopulation rates and the locations of the lowest negative residuals (Figures 10 and 37). These counties had much higher losses of farm people than could be explained by the agricultural components selected by a stepwise multiple regression and were found in the eastern most part of the Region and in northwestern Pennsylvania. Some of these counties had a high dependency on labor oriented agriculture which was not conducive to the retention of farm workers (Figure 27). The eastern fringe of the northern Appalachians had high farm population losses probably related to the spillover effects of Megalopolis.

Some counties' farm population changes were explained by linear regressions when there had been no explanation given by the multiple regression. The western Pennsylvanian counties of Butler and Lawrence had farm population changes associated with dairying versus off the farm work component and capital intensive agriculture, respectively; while, Greene and Crawford agricultural changes were related to both agricultural components. Potter and Cortland's farm population retention rates were associated with dairying versus off the farm work component. The rates of Columbia, Mifflin, and Schoharie related to the capital intensive agriculture. Apparently in the multiple regression some of the other agricultural subsystems interacted with the farm population changes of these anomalous counties in a different manner than for the majority of the counties. The whole of agriculture is really greater than the sum of the subsystems of agriculture.

The counties with the best retention of agriculturally employed persons had most of the highest positive residuals. There existed reasons other than the selected agricultural components for the lowest rates of farm depopulation in these counties. Partly because plentiful cropland and good soils lend a basic advantage to farming operations, the counties of central Pennsylvania were somewhat more successful than most counties of the northern Appalachians in holding persons on farms. More persons could stay on farms through their employment in new local industries. Some of the counties were among the most economically viable in the Region.

The Importance of Time Lag Effects of Agriculture

From this exploratory study of the possible associations of agricultural systems, components, and characteristics with farm depopulation, some assessments were formed. The changing nature of the various aspects of agriculture in general have had a role in the relative stability and change of the population engaged in agricultural employment on the farms. The study of agricultural qualities as associated with farm population declines has given insufficient attention to the lag of the farm population responses to agricultural changes.

Prior to the post-World War II era, the farm population had less inclination for moving than any other major group of Americans. Farm persons have had stronger ties to the land and family than probably any other group; therefore, they have traditionally been more reluctant to leave farming than in general other employed persons have been to leave their work or residence. Many farm families postponed their departures for many years. The man-land theme in geography was especially pertinent for studies of the agricultural populations; but, unfortunately, the people have been studied much less by geographers than the features of the rural landscape. The general tendency of a large proportion of the population on farms to respond to various causes and stimuli belatedly has had very limited and insufficient recognition.

In an attempt to illustrate statistically the continued significance of the lag effects of changes in the agricultural components on the farm population, a stepwise multiple regression using the 1950 agricultural component scores with the change rates in the farm population was carried out. In explaining the farm population changes during the 1960s in the northern Appalachians, the 1970 agricultural component scores produced an R of .733 compared to an R of .630 with the 1950 agricultural component scores. The latter correlation indicated an important continued relationship between the nature of agriculture ten to twenty years prior to the losses of persons from the farms in the 1960s. The past status of agriculture had nearly as much influence on the agricultural population changes in the 1960s as did the concurrent status of agriculture (Figures 38 and 39). One would expect if the recent past agricultural history has had such an important relationship to the contemporary farm population changes, then in past American history the importance of the lag effects on

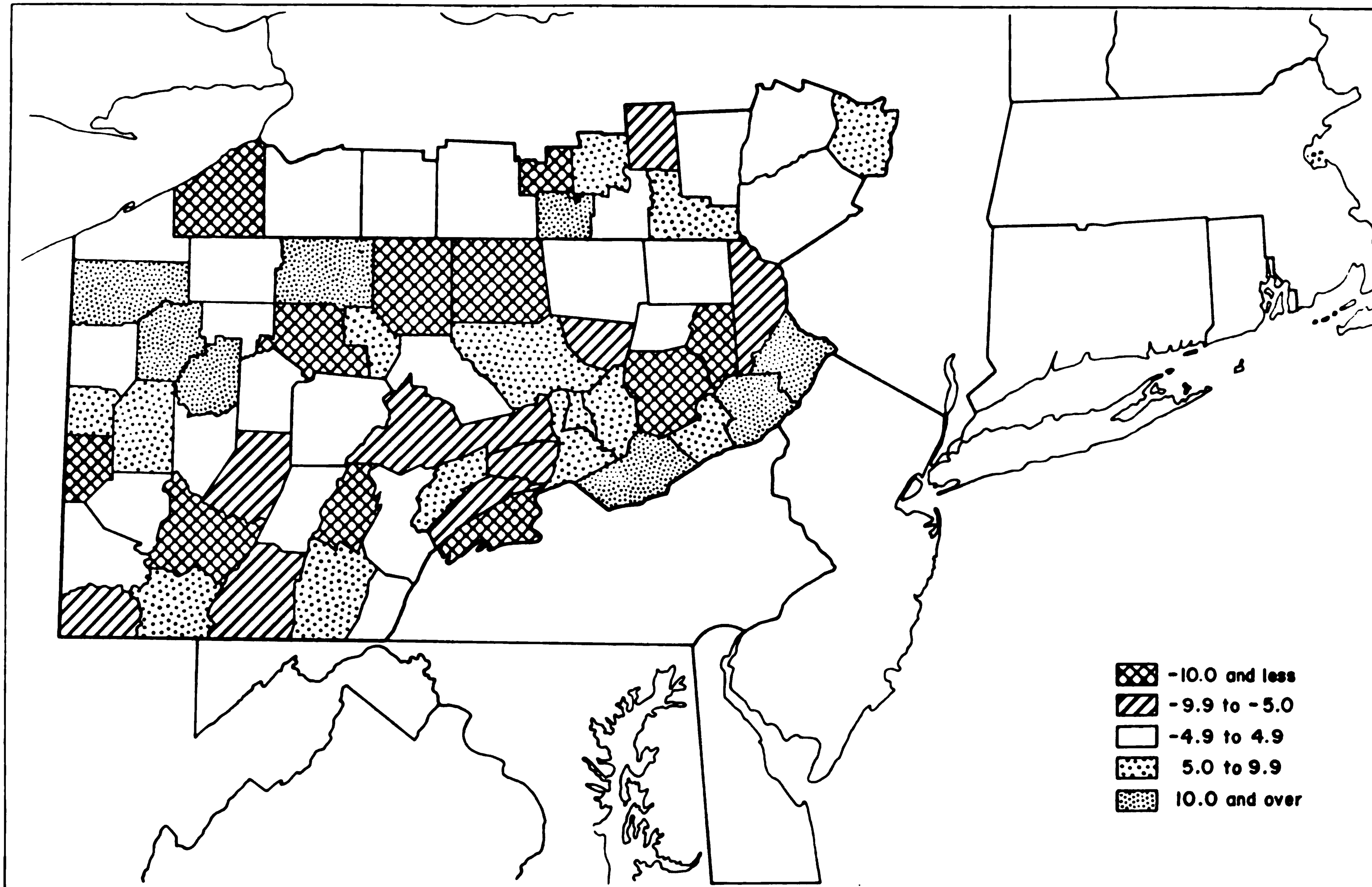

Fig. 39.--Residuals from Regression of Retention Rates of Farm Population, 1960-1970, on Scores of Associated Agricultural Components, 1949-1950.

later farm population changes were even greater, given the relatively rapid pace of change in modern economic societies.

CHAPTER 9

SUMMARY, CONCLUSIONS, AND THE IMPLICATIONS FOR FUTURE RESEARCH

Summary

The Problem

The fundamental task of this research project was to determine if there was in fact important relationships between the large decreases in a regional farm population of the United States, i.e., of the northern Appalachians, and the rapid changes occurring within the agricultural sector of the study area. Agriculture in the United States is a complex of interacting parts; and, although it may be perceived as one system, it is composed of several subsystems, most represented in varying degrees in each type of farming. It was generally hypothesized that agricultural technology has intersected these segments of agriculture differently and the impact has varied depending upon the existing natural and geographical setting. The subsystems of mechanization, capital investment, other off farm inputs, labor, land and production were derived from agricultural variables that seemingly would have been significantly altered by new technology. Similarities in the basic resources used in each type of farming however permitted considerable generalization on the changes within agriculture. The major questions that guided the research and analysis for each time period, 1910 to 1930, 1950 to 1960, and 1960 to 1970 pertained to:

(1) the patterns of farm depopulation

(2) the general nature of agriculture

(3) the importance of certain subsystems in the several areas

(4) the relationships of subsystems as indicators of technological forces to farm depopulation.

The Procedure of Analysis

A choice of study area was selected that would represent a wide range of natural environmental conditions in addition to the manifestation of serious farm depopulation over several decades. These requirements were met by the chosen area of study, the northern Appalachian region of western and northern Pennsylvania and the southern edge of upstate New York. This area coincided with the northern portion of the Appalachian Region. The region's boundaries were delineated by the various Appalachian acts and amendments of the United States Congress. The regional research was aided by the writer's considerable familiarity with the chosen area.

To represent and measure the magnitude and extent of the decreasing farm population problem, termed in this study as farm depopulation; ratios and/or proportions of farm populations of an earlier base year were calculated. The structure of the data available from the several United States Censuses of Population influenced to some extent the selection of the time frame of the study. The farm population was first directly enumerated in 1920; however, because of some basic calculations of average farm family size in 1910, estimates of the farm population for this year were made. Around this time the population of farms began a notable decline. The time periods of this research corresponded with the census decades from 1910 to 1970, except the 1930 decade and 1940 decade received little attention because of the staggering influence of "extraneous forces" of the Great Depression and World War II which disrupted the usual situation.

Counties served as the geographical unit of analysis and data consisting in the form of percentages, ratios, and averages represented both the dependent and independent variables. Analysis at this geographical scale was thought preferable because of the wide availability of published data on the county level and the need to aggregate the data in such a manner that would easily convey a general assessment of the natural environment.

The mapped farm depopulation or retention percentages for the periods of 1910-1930, 1940-1950, 1950-1960, and 1960-1970 produced some areal patterns that prompted both natural and agricultural hypotheses for the farm population losses. Thus, agricultural variables were chosen that appeared to best reflect the overall technological hypothesis. The selected variables primarily fitted the resource inputs and types of farming aspects of agriculture.

Twenty-one agricultural variables (Appendices A and B) were submitted as inputs into a principal components analysis for each time period and the basic dimensions of the Region's agriculture interpreted from the major extracted components. The principal components were defined by the way each agricultural variable loaded (correlated) with each component. The principal components met the assumption of independence and were then placed with the farm population retention ratios in a stepwise multiple regression program. The amount of association each agricultural component had with the farm population change and the amount of the total variation in the dependent variable each additional component accounted for were obtained.

Finally, residuals of regression were mapped for certain components that had important statistical association with the farm population ratios in addition to the collective groups of components. The areal patterns gave clues for additional hypotheses and explanations.

Findings and Results

Throughout the time periods of study, parts of western and west central Pennsylvania had the highest farm depopulation rates. Another subarea that tended to have considerable relative farm depopulation was the Pocono Plateau of northeastern Pennsylvania.

The ridge and valley physiographical province of Pennsylvania, especially in south central Pennsylvania, had the least farm depopulation. Parts of southern New York, particularly the southeastern dairying counties and adjacent eastern areas of Pennsylvania retained their farm populations somewhat more than the Region as a whole.

The average retention or depopulation rates were generally the most accounted for statistically. The cropland availability component was associated positively with farm population retention in the 1910 to 1930 period. In the time periods of the 1960s and 1970s, dairying counties best sustained their population on the farms; whereas, off farm employment of farm operators led to higher rates of farm population losses, especially in western Pennsylvania.

For the 1950 decade the proportion of the total variance accounted for by the agricultural components of 1949-50 equaled an R^2 of .826. There was somewhat less statistical explanation given by the 1969-70 agricultural components for the 1960s; R^2 equaled .733.

Conclusions and Implications for Research

Many minor findings resulted from this research. Both the findings not listed in this chapter and the major findings listed above lead to certain generalizations and conclusions. Technological forces had only a moderate influence on the farm population via agricultural changes prior to World War II; however, after this War, the technologically-based changes in agriculture have been much more associated with agricultural depopulation. The analysis of the Region's agriculture for the 1960s revealed that agriculture is now more heterogeneous in its characteristics; therefore, generalization about agriculture in the future will be more difficult. Areas dominated by primary economic activities had farm depopulation not well explained by this study. Urban areas had less farm depopulation relatively than expected which might suggest that conditions in the rural areas were more associated recently with farm population losses. Future studies of farm depopulation should be carried out in the field in those areas where explanation was not given by the technological thesis.

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APPENDIX A

VARIABLES INCLUDED IN THE RESEARCH

APPENDIX A

VARIABLES INCLUDED IN THE RESEARCH

Agricultural and Population Variables in the Correlation Matrices*

Independent Variables for 1910

1. Average value of land and buildings per farm acre
2. Average value of implements and machinery per farm acre
3. Average expenditure for feed per farm reporting
4. Average expenditure for fertilizer per farm reporting
5. Farm persons per 100 acres
6. Value of hired labor per farm reporting
7. Average size farm in acres
8. Average cropland harvested acreage
9. Percentage harvested cropland, hay
10. Corn yields in bushels per acre
11. Land productivity: Agricultural sales per acre
12. Labor productivity: Agricultural sales per agricultural person
13. Ratio farm expenses to value of agricultural products

Independent Variables for 1930, 1950, 1970

1. Percentage of farms reporting tractors
2. Percentage of farms reporting automobiles
3. Percentage of farms reporting trucks
4. Average dollars spent per farm for gas
5. Average value of land and buildings per farm acre
6. Average value of implements and machinery per farm acre
7. Average expenditure for feed per farm reporting
8. Average expenditure for fertilizer per farm reporting
9. Farm persons per 100 acres
10. Value of hired labor per farm reporting
11. Average size of farm in acres
12. Average cropland acreage per farm reporting

*Unless otherwise indicated the raw data represents the census year or the previous year.

13. Percentage cropland harvested
14. Percentage harvested cropland, hay
15. Pastureland-cropland ratio
16. Percentage of total farms that are dairy
17. Corn yields in bushels per acre
18. Land productivity: Agricultural sales per acre
19. Labor productivity: Agricultural sales per agricultural person
20. Ratio of farm expenditures to value of agricultural products
21. Percentage farm operators working 100 days off the farm

APPENDIX B

SOURCES OF DATA

APPENDIX B

SOURCES OF DATA

Variable Number	Source
1	U.S. Bureau of the Census. U.S. Census of Agriculture: 1925. Part 1 (The Northern States).
1, 2, 3, 4, 7, 9, 10, 11, 12, 13, 15, 17, 18, 19, 20, 21	U.S. Bureau of the Census. U.S. Census of Agriculture: 1950. Vol. 1. Counties and State Economic Areas. Part 2 (Middle Atlantic States).
1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20	U.S. Bureau of the Census. U.S. Census of Agriculture: 1969. Vol. 1. Area Reports. Part 7 (New York) and Part 9 (Pennsylvania).
2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20*	U.S. Bureau of the Census. U.S. Census: 1930. Agriculture Vol. 2. Part 1. The Northern States.
4,[a] 21[b]	U.S. Bureau of the Census. U.S. Census: 1940. Agriculture Vol. 1. Part 1. Statistics for Counties.
5, 6, 7, 8, 9, 10, 11, 12,* 14, 17, 18,* 19,* 20*	U.S. Bureau of the Census. U.S. Census: 1910. Vol. 7. Agriculture Reports by States with Statistics by Counties
5,* 21	U.S. Bureau of the Census. County and City Data Book. 1972 and 1973.
6[c]	U.S. Bureau of the Census. U.S. Census of Agriculture: 1945. Vol. 1. Part 2 (Middle Atlantic States).

Variable Number	Source
8,[d] 16	U.S. Bureau of the Census. U.S. Census of Agriculture: 1954. Vol. 1. Counties and State Economic Areas. Part 2 (Middle Atlantic States).
16[e]	U.S. Bureau of the Census. U.S. Census of Agriculture: 1964. Statistics for the States and Counties.
18, 19	U.S. Bureau of the Census. U.S. Census: 1930. Agriculture. Vol. 3. Type of Farm. Part 1 (The Northern States).

Notes:

Census volumes are published by the United States Government Printing Office.

The dependent variable information is available in Chapter III.

Appendix B needs to be used with Appendix A. Although numbered sequentially each variable for 1910 is given the same number as for 1930, 1950, and 1970.

Most variables are expressed in relative measures calculated from absolutes by the author.

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[a] 1940 data.

[b] Total operators working off farms.

[c] 1945 data.

[d] 1954 data.

[e] 1964 data.

*Special tabulations and aggregative calculations.

APPENDIX C

CORRELATION COEFFICIENTS MATRIX (1909-1910)

APPENDIX C

CORRELATION COEFFICIENTS MATRIX (1909-1910)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.0000	.6313	.2141	.2757	.5785	.5150	-.4754	-.1091	-.1641	.2334	.3948	-.0233	.1990
2	.6313	1.0000	.1364	.6471	.6664	.4443	-.6581	.2339	-.2466	-.1059	.5498	.0852	.1663
3	.2141	.1364	1.0000	.1545	-.1959	.6932	.2100	-.1197	.6497	.3124	.5814	.7278	.4675
4	.2757	.6471	.1545	1.0000	.4100	.4473	-.3390	.0103	-.3438	-.4033	.1660	-.0958	.5243
5	.5785	.6664	-.1959	.4100	1.0000	.0234	-.9170	-.2638	-.3410	-.1247	.1319	-.4434	.1431
6	.5150	.4443	.6932	.4473	.0234	1.0000	.0219	-.1329	.3055	.2137	.4813	.3930	.6517
7	-.4754	-.6581	.2100	-.3390	-.9170	.0219	1.0000	.1259	.2232	.0307	-.2226	.3085	.0493
8	-.1091	.2339	-.1197	.0103	-.2638	-.1329	.1259	1.0000	-.2675	-.1164	.3444	.4444	-.5743
9	-.1641	-.2466	.6497	-.3438	-.3410	.3055	.2232	-.2675	1.0000	.4924	.3468	.5570	.1600
10	.2334	-.1059	.3124	-.4033	-.1247	.2137	.0307	-.1164	.4924	1.0000	.3633	.4256	-.1911
11	.3948	.5498	.5814	.1660	.1319	.4813	-.2226	.3444	.3468	.3633	1.0000	.7419	-.0680
12	-.0233	.0852	.7278	-.0958	-.4434	.3930	.3085	.4444	.5570	.4256	.7419	1.0000	-.1508
13	.1990	.1663	.4675	.5243	.1431	.6517	.0493	-.5743	.1600	-.1911	-.0680	-.1508	1.0000

APPENDIX D

CORRELATION COEFFICIENTS MATRIX (1929-1930)

APPENDIX D

CORRELATION COEFFICIENTS MATRIX (1929-1930)

	1	2	3	4	5	6	7	8	9	10
1	1.0000	.3169	.2775	.4229	.2103	.2921	.0472	.0730	.1730	.2823
2	.3169	1.0000	.0246	-.0004	-.0895	-.0963	-.1565	-.1741	-.2756	-.1008
3	.2775	.0246	1.0000	.5820	.3089	.4624	.3697	.2714	.2323	.6796
4	.4229	-.0004	.5820	1.0000	.6109	.2728	.1272	.0539	.3045	.7300
5	.2103	-.0895	.3089	.6109	1.0000	.1092	-.1747	-.1694	.6529	.6586
6	.2921	-.0963	.4624	.2728	.1092	1.0000	.8785	.9201	.4432	.4217
7	.0472	-.1565	.3697	.1272	-.1747	.8785	1.0000	.9650	.0719	.3461
8	.0730	-.1741	.2714	.0539	-.1694	.9201	.9650	1.0000	.1901	.2409
9	.1730	-.2756	.2323	.3045	.6529	.4432	.0719	.1901	1.0000	.2856
10	.2823	-.1008	.6796	.7300	.6586	.4217	.3461	.2409	.2856	1.0000
11	-.1716	.2837	-.0911	-.2445	-.5629	-.4064	-.0460	-.1639	-.8991	-.1648
12	.5090	.6495	-.0227	.0007	-.2702	-.1015	-.1421	-.1587	-.3622	-.1185
13	.0791	.3941	.0549	-.0611	-.1824	-.0244	.0392	-.0432	-.2933	-.0804
14	-.3783	-.2267	.0723	.0619	-.2030	-.1370	.2393	.0374	-.5111	.1810
15	-.5748	-.2591	-.0798	-.1148	-.2354	-.2095	.1756	.0323	-.5229	-.0278
16	.0782	.1904	.2345	.0583	-.2530	-.0235	.2498	.0461	-.5664	.1875
17	.1747	.0531	.1895	.3791	.0601	.0445	.1006	-.0240	-.0558	.2509
18	.5145	.1397	.6970	.6521	.4800	.5424	.3573	.2605	.3976	.6810
19	.2255	.3011	.4192	.3136	-.1897	.0372	.2615	.0385	-.5479	.3652
20	-.0693	-.2657	.5946	.4565	.4659	.3508	.3674	.2470	.2363	.7274
21	-.2212	-14964	-.2668	-.0379	.2130	-.0671	-.1224	-.0270	.4159	-.0291

	11	12	13	14	15	16	17	18	19	20	21
1	-.1716	.5090	.0791	-.3783	-.5748	.0782	.1747	.5145	.2255	-.0693	-.2212
2	.2837	.6495	.3941	-.2267	-.2591	.1904	.0531	.1397	.3011	-.2657	-.4964
3	-.0911	-.0227	.0549	.0723	-.0798	.2345	.1895	.6970	.4192	.5946	-.2668
4	-.2445	.0007	-.0611	.0619	-.1148	.0583	.3791	.6521	.3136	.4565	-.0379
5	-.5629	-.2702	-.1824	-.2030	-.2354	-.2530	.0601	.4800	-.1897	.4659	.2130
6	-.4064	-.1015	-.0244	-.1370	-.2095	-.0235	.0445	.5424	.0372	.3508	-.0671
7	-.0460	-.1421	.0392	.2393	.1756	.2498	.1006	.3573	.2615	.3674	-.1224
8	-.1639	-.1587	-.0432	.0374	.0323	.0461	-.0240	.2605	.0385	.2470	-.0270
9	-.8991	-.3622	-.2933	-.5111	-.5229	-.5664	-.0558	.3976	-.5479	.2363	.4159
10	-.1648	-.1185	-.0804	.1810	-.0278	.1875	.2509	.6810	.3652	.7274	-.0291
11	1.0000	.4344	.3053	.4332	.4664	.5452	.0167	-.3610	.5376	-.2372	-.3616
12	.4344	1.0000	.5652	-.2560	-.3901	.3213	.1404	.1933	.4728	-.5602	-.5337
13	.3053	.5652	1.0000	.1467	.1877	.4687	.1320	.2715	.5065	-.2822	-.6375
14	.4332	-.2560	.1467	1.0000	.8489	.6652	.2315	-.0291	.5490	.4169	-.1020
15	.4664	-.3901	.1877	.8489	1.0000	.4722	.0383	-.2736	.2950	.2560	-.0510
16	.5452	.3213	.4687	.6652	.4722	1.0000	.2088	.2788	.8161	.1678	-.4670
17	.0167	.1404	.1320	.2315	.0383	.2088	1.0000	.3971	.4793	.1548	-.1798
18	-.3610	.1933	.2715	-.0291	-.2736	.2788	.3971	1.0000	.5056	.4206	-.2805
19	.5376	.4728	.5065	.5490	.2950	.8161	.4793	.5056	1.0000	.1971	-.5785
20	-.2372	-.5602	-.2822	.4169	.2560	.1678	.1548	.4206	.1971	1.0000	.0553
21	-.3616	-.5337	-.6375	-.1020	-.0510	-.4670	-.1798	-.2805	-.5785	.0553	1.0000

APPENDIX E

CORRELATION COEFFICIENTS MATRIX (1949-1950)

APPENDIX E

CORRELATION COEFFICIENTS MATRIX (1949-1950)

	1	2	3	4	5	6	7	8	9	10
1	1.0000	.5549	.1598	.5298	-.0026	.5488	.1245	.5260	-.0594	.1088
2	.5549	1.0000	-.0007	.2549	-.2027	.1073	.1511	.3012	-.2791	-.1040
3	.1598	-.0007	1.0000	.2162	.2813	.3232	.4317	.2593	.1005	.4360
4	.5298	.2549	.2162	1.0000	-.0237	.4863	.4058	.6834	-.2696	.1822
5	-.0026	-.2027	.2813	-.0237	1.0000	.6267	-.0457	.0281	.6835	.6088
6	.5488	.1073	.3232	.4863	.6267	1.0000	.0672	.4544	.5413	.4026
7	.1245	.1511	.4317	.4058	-.0457	.0672	1.0000	.1413	-.4909	.2464
8	.5260	.3012	.2593	.6834	.0281	.4544	.1413	1.0000	-.0994	.1072
9	-.0594	-.2791	.1005	-.2696	.6835	.5413	-.4909	-.0994	1.0000	.2128
10	.1088	-.1040	.4360	.1822	.6088	.4026	.2464	.1072	.2128	1.0000
11	.0775	.2181	.0096	.3000	-.7019	-.5174	.4866	.1094	-.9231	-.0839
12	.6067	.4482	-.0924	.7847	-.4001	.2088	.3071	.5478	-.5049	-.0645
13	.5382	.2331	.0281	.5966	.0082	.5690	.3708	.3237	-.0773	-.0437
14	-.3792	-.1654	.2671	-.3376	-.1721	-.5199	.4475	-.4874	-.3903	.1082
15	-.3670	-.1772	.1306	-.2221	-.2535	-.5306	.4699	-.4434	-.5291	.0153
16	.2406	.1508	.1033	.3795	-.3437	-.1106	.6154	-.0111	-.6745	.0417
17	.2176	.1384	-.3578	.1619	.0341	.1540	-.1406	.0685	.0937	-.0121
18	.3581	.0673	.4529	.5404	.5527	.7165	.6322	.3577	.1087	.5809
19	.2593	.2031	.3306	.5767	-.0671	.1334	.9153	.2875	-15876	.3006
20	-.0776	.0958	.3532	-.2680	.2811	.0246	.0002	-.2178	.3531	.2241
21	-.1665	-.2409	-.1142	-.5975	.4022	.0197	-.6866	-.3059	.6830	.0835

	11	12	13	14	15	16	17	18	19	20	21
1	.0775	.6067	.5382	-.3792	-.3670	.2406	.2176	.3581	.2593	-.0776	-.1665
2	.2181	.4482	.2331	-.1654	-.1772	.1508	.1384	.0673	.2031	.0958	-.2409
3	.0096	-.0924	.0281	.2671	.1306	.1033	-.3578	.4529	.3306	.3532	-.1142
4	.3000	.7847	.5966	-.3376	-.2221	.3795	.1619	.5404	.5767	-.2680	-.5975
5	-.7019	-.4001	.0082	-.1721	-.2535	-.3437	.0341	.5527	0.0671	.2811	.4022
6	-.5174	.2088	.5690	-.5199	-.5306	-.1106	.1540	.7165	.1334	.0246	.0197
7	.4866	.3071	.3708	.4475	.4699	.6154	-.1406	.6322	.9153	.0002	-.6866
8	.1094	.5478	.3237	-.4874	-.4434	-.0111	.0685	.3577	.2875	-.2178	-.3059
9	-.9231	-.5049	-.0773	-.3903	-.5291	-.6745	.0937	.1087	-.5876	.3531	.6830
10	-.0839	-.0645	-.0437	.1082	.0153	.0417	-.0121	.5809	.3006	.2241	.0835
11	1.0000	.5304	.0477	.4496	.5549	.7120	-.0936	-.1154	.5891	-.3303	-.6839
12	.5304	1.0000	.6022	-.2753	-.1912	.4806	.1827	.2749	.5342	-.4647	-.6514
13	.0477	.6022	1.0000	-.2481	-.0875	.4198	.2021	.5513	.4817	-.2760	-.5099
14	.4496	-.2753	-.2481	1.0000	.8986	.5629	-.2675	-.0512	.3513	.0701	-.2235
15	.5549	-.1912	-.0875	.8986	1.0000	.6474	-.1900	-.0426	.4195	-.0644	-.3370
16	.7120	.4806	.4198	.5629	.6474	1.0000	.0541	.2677	.7268	-.3242	-.7388
17	-.0936	.1827	.2021	-.2675	-.1900	.0541	1.0000	.0720	-.0044	-.2088	.0831
18	-.1154	.2749	.5513	-.0512	-.0426	.2677	.0720	1.0000	.6855	-.0738	-.3525
19	.5891	.5342	.4817	.3513	.4195	.7268	-.0044	.6855	1.0000	-.2723	-.7641
20	-.3303	-.4647	-.2760	.0701	-.0644	-.3242	-.2088	-.0738	-.2723	1.0000	.3761
21	-.6839	-.6514	-.5099	-.2235	-.3370	-.7388	.0831	-.3525	-.7641	.3761	1.0000

APPENDIX F

CORRELATION COEFFICIENTS MATRIX (1969-1970)

APPENDIX F

CORRELATION COEFFICIENTS MATRIX (1969-1970)

	1	2	3	4	5	6	7	8	9	10
1	1.0000	.4730	.2738	.2197	-.4139	-.0499	.0877	.1229	-.2102	-.1089
2	.4730	1.0000	.1886	.5639	-.2148	-.0625	.4321	.3803	-.0434	-.1686
3	.2738	.1886	1.0000	.2508	.2877	.2314	.0718	.3614	.1629	.1721
4	.2197	.5639	.2508	1.0000	.0802	.1643	.6634	.7904	.1996	.1727
5	-.4139	-.2148	.2877	.0802	1.0000	.6600	.0449	.1713	.6108	.4807
6	-.0499	-.0625	.2314	.1643	.6600	1.0000	-.0599	.2371	.7441	.3693
7	.0877	.4321	.0718	.6634	.0449	-.0599	1.0000	.4215	.0294	.1138
8	.1229	.3803	.3614	.7904	.1713	.2371	.4215	1.0000	.1481	.0861
9	-.2102	-.0434	.1629	.1996	.6108	.7441	.0294	.1481	1.0000	.2671
10	-.1089	-.1686	.1721	.1727	.4807	.3693	.1138	.0861	.2671	1.0000
11	.3186	.4817	-.1226	.3924	-.5879	-.7136	.3924	.1874	-.5953	-.2177
12	.3354	.5847	.0900	.8128	-.2827	-.1537	.4707	.6551	-.0941	-.0551
13	.2598	.4150	.2897	.6268	.3019	.5856	.2771	.6456	.5202	.1080
14	.0725	.1036	-.2482	-.1530	-.3736	-.6156	.1973	-.4749	-.4382	-.1830
15	.0809	.0423	-.2518	-.1400	-.2741	-.4825	.2359	-.3963	-.3692	-.0165
16	.3004	.5217	-.1668	.5812	-.3307	-.3531	.6124	.2294	-.1397	-.1960
17	.0535	-.0211	-.2856	-.0210	-.2549	.1243	-.2482	-.1151	.0706	.0036
18	-.0925	.0700	.1875	.5547	.5956	.6220	.4952	.4152	.6458	.6723
19	.1020	.0304	.0742	.4106	.1844	-.0062	.5552	.2840	-.2434	.6104
20	-.2942	-.5331	.2492	-.3560	.3900	.1519	-.0298	-.1336	-.0385	.3029
21	-.2204	-.6607	.1164	-.6421	.1228	.1165	-.6157	-.3175	-.0902	.0774

	11	12	13	14	15	16	17	18	19	20	21
1	.3186	.3354	.2598	.0725	.0809	.3004	.0535	-.0925	.1020	-.2942	-.2204
2	.4817	.5847	.4150	.1036	.0423	.5217	-.0211	.0700	.0304	-.5331	-.6607
3	-.1226	.0900	.2897	-.2482	-.2518	-.1668	-.2856	.1875	.0742	.2492	.1164
4	.3924	.8128	.6268	-.1530	-.1400	.5812	-.0210	.5547	.4106	-.3560	-.6421
5	-.5879	-.2827	.3019	-.3736	-.2741	-.3307	-.2549	.5956	.1844	.3900	.1228
6	-.7136	-.1537	.5856	-.6156	-.4825	-.3531	.1243	.6220	-.0062	.1519	.1165
7	.3924	.4707	.2771	.1973	.2359	.6124	-.2482	.4952	.5552	-.0298	-.6157
8	.1874	.6551	.6456	-.4749	-.3963	.2294	-.1151	.4152	.2840	-.1336	-.3175
9	-.5953	-.0941	.5202	0.4382	-.3692	-.1395	.0706	.6458	-.2434	-.0385	-.0902
10	-.2177	-.0551	.1080	0.1830	-.0165	-.1960	.0036	.6723	.6104	.3029	.0774
11	1.0000	.6479	-.1637	.5909	.5109	.7092	-.0063	0.2902	.2812	-.4580	-.5506
12	.6479	1.0000	.4512	-.0131	-.0571	.6229	.1302	.1955	.2806	-.5337	-.5847
13	-.1637	.4512	1.0000	-.5370	-.4253	.1774	.0593	.5699	.0872	-.3501	-.3441
14	.5909	-.0131	-.5370	1.0000	.7669	.4916	-.0471	-.3422	.0966	-.1868	-.3272
15	.5109	-.0571	-.4253	.7669	1.0000	.3927	-.2180	-.1980	.2399	-.0831	-.2545
16	.7092	.6229	.1774	.4916	.3927	1.0000	.0567	.1094	.2490	-.5924	-.7590
17	-.0063	.1302	.0593	-.0471	-.2180	.0567	1.0000	-.0283	-.1418	-.3688	.0193
18	-.2902	.1955	.5699	-.3422	-.1980	.1094	-.0283	1.0000	.5327	.0300	-.3061
19	.2812	.2806	.0872	.0966	.2399	.2490	-.1418	.5327	1.0000	.1624	-.2223
20	-.4580	-.5337	-.3501	-.1868	-.0831	-.5924	-.3688	.0300	.1624	1.0000	.6340
21	-.5506	-.5847	-.3441	-.3272	-.2545	-.7590	.0193	-.3061	-.2223	.6340	1.0000