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Techniques for analyzing farm family level of living and related factors in Iowa

Paul Joseph Jehlik

Iowa State College

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UMI®
TECHNIQUES FOR ANALYZING FARM FAMILY LEVEL
OF LIVING AND RELATED FACTORS IN IOWA

by

Paul J. Jehlik

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major Subject: Rural Sociology

Approved:

Signature was redacted for privacy.

In Charge of Major Work

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Dean of Graduate College

Iowa State College

1952
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I. INTRODUCTION
levels of living exists in what parts of the state? How are levels of living related to crop productivity, corn yield, size of farm, percent of tenancy, farm mechanization, value of land and buildings, population density, population change, percent rural farm population, percent of persons of foreign birth and of mixed parentage and social participation? What is the ecology of the relationships between levels of living and certain of the above factors? What types of areas appear to be best adapted for discriminating variations in levels of living? What is the significance of the relationships and the implications? What are the suggested next steps for research?

Some of the fundamental problems which arise in the area of analysis of levels of living were indicated. The study may be described as empirical, since concrete evidence was presented throughout to substantiate certain propositions and conclusions.

B. Origin of the Study

An adequate and satisfying level of living is a goal deeply rooted in American traditions. It persists strongly as a major goal of farm people, even though its achievement is not always readily or uniformly realized. The failure of many farm families to be securely situated with respect to an adequate and satisfying level of living is to them a continually perplexing problem. The traditional thinking among many people is that a satisfactory level of living is within the reach of any individual, family or group. The
shortcomings of this expectation are a major concern of students of human welfare.

Some areas in Iowa known to the writer seem to be characterized by much uniformity in the levels of living of the families, who appear to be well integrated into the social fabric of those areas. In still other areas, large enough differences in level of living exist so that a lack of integration or unanimity of purpose in community activity becomes apparent. In a study in Ohio, which doubtless has implications for other areas, Mangus and Cottam found evidence to

... indicate a highly significant relationship between level of living and total adjustment. Statistical tests provide assurance that this relationship is characteristic among Ohio farm people in general, as well as among those included in the sample. A high level of living does not guarantee contentment nor a low level of living its opposite; nevertheless, the chances of a completely satisfactory life are probably from three to four times greater for those near the top of the scale of living than for those near the bottom.¹

In a study of Oklahoma farm families, Sewell arrived at the same general conclusion as the Ohio authors.

Differences in socio-economic status among families are observed readily by all who study human social behavior. That these differences profoundly affect members of the family, especially the children is a well accepted fact. That the individual's conception of his social role is definitely conditioned by his home background is one of the fundamental premises upon which modern social psychology.

child guidance, and sociology are predicated. That a family will struggle to raise its status if it is low, or fight to maintain it when it is threatened, is a fact apparent in all societies.

Students of rural society, no less than others, have long been aware of these facts. Likewise, they have recognized that differences in socio-economic status so greatly influence the social behavior of rural people that it is necessary to control this factor in studies where other aspects of behavior are being compared.¹

Despite the large number of level of living studies which have been made, little is yet known about areal variations in levels of living and the whole complex of factors operating in each area. Nor is much known about the effect of areal variations in levels of living on social behavior of families and groups within each of the areas. A succinct summary of the history of studies of family living in the United States and Canada indicated that

... there has never been a comprehensive study of the living of all groups in the population. More than that, there has never been an adequate study of the living of all the social and economic groups in any one state or in any one city.

Studies of farm family living in certain counties in the United States have received a more adequate representation of all the social and economic groups in the community than have any of the urban studies. There has never been, however, a study of farm family living which included enough communities to give an adequate picture of all the important farm groups in the country. The material so far gathered can be used with the aid of census statistics only to sketch, in very broad outlines, the conditions of living and the consumption habits of the farm population.

Studies of family living in Canada are still too few and too small in scope to give any indication of living conditions and consumption habits within the Dominion.¹

Studies of rural life have involved the consideration of locality groupings as the basic social units of inquiry. Such social units ranged from neighborhoods to communities, cultural areas, sub-regions and regions. Many leading sociologists are identified with particular community studies. The identification of the ecological patterns of farm family levels of living usually was not given serious consideration, although the problem was generally recognised. Various text book authors in the field of rural sociology make some reference to the problem.²

Since 1935, most of the studies concerned with areal aspects of levels of living have been confined to analysing and portraying regional differentials in the well-being of the nation's farm people.


Sanderson, Dwight and Polson, Robert A. Rural sociology and rural social organization. N. Y., John Wiley and Sons. 1942. p. 121-125.
Taylor, Wheeler and Kirkpatrick\(^1\), Hagood\(^2\), Schuler\(^3\), Mangus\(^4\), Odum\(^5\), and Odum and Moore\(^6\) may be considered as pioneers in these researches. These gross differentiations were necessary to the more specific and definitive variations in which social scientists recently have become interested. Studies such as those of Lively and Almack\(^7\), Lively and Gregory\(^8\), Hagood, Danilevsky and Beum\(^9\) are examples of the latter approach.


\(^6\)and Moore, Harry E. American regionalism. N. Y. Henry Holt and Co., Inc. 1938.


Correlation, intercorrelation and regression analyses of level of living and related factors data used by Mangus, Lively, Hagoed and Sewell were important contributions to the literature on farm family level of living and helped greatly to remove this area of research from the usual practice of mere description.

The findings of the above mentioned researchers, the general movement in the social sciences toward more definitive spatial delineations of variations in social phenomena, including levels of living, the limitation of much sub-regionalization work in Iowa to type of farming areas and the fact that farm family level of living indexes could be computed for townships gave specific stimulus to this study. The writer assumed that a more precise delineation of the spatial variations in levels of living of farm families could be done. It was assumed further that such delineated variations carry different associational relationships with certain economic, physical and social factors. A secondary consideration growing out of the foregoing was that the use of such identifications and relationships could be employed in other researches to facilitate the discovery and refinement of significant relationships which may be presently obscured.

With so much variation in levels of living among the farm families, the averages for all families on any large formal area basis are of little significance. Many discussions and writings are concerned with problems of raising the levels of living of farm families,
yet it is not always recognized that the wide variations may be the
result of varying complexes of factors. Legislation establishing
programs affecting farm families is passed which has uniform applica-
tion to all sectors of the farm population. Policies and procedures
for public and private programs often are prepared without due
regard to the variable ability of the population to respond to them.
Such approaches often defeat the very purpose which they set out to
accomplish. They represent the application of uniform treatment to
a heterogeneous situation.

C. Plan of Work

When the general purposes of the study had been decided upon,
then considerable exploratory work for choice of procedures in the
development of the study followed. Limitations were set by the nature
and availability of the data. In each of the applicable chapters,
procedures and techniques are described, and their usefulness in
yielding valid results indicated. How well the choice of procedures
and techniques met the demands of a study such as this can be deter-
mined only from the added clarification obtained of the existent
levels of living among farm families in Iowa.

Any generalizations from this study apply to the farm families
as they are included, or excluded, through delineation of any
individual area or areas. Ideally, the measure of variation in
levels of living of farm families would be best depicted by an index pertaining to each individual family. However, to study the universe in such detail was not within the province of this effort or within the limitations of the resources available. Furthermore, most types of information on individual families needed for such a study are not available from secondary sources. For most of the analysis in this study farm family level of living indexes by townships served as the basic units. The township was the smallest unit on which much aggregated data could be obtained. It reveals variations not shown by a unit as large as a county, therefore was well adapted for the more precise delineations and for the analysis of relationship of farm family levels of living to selected variables in the various areas.

D. Prosperous, Commercial Agriculture

Commercial agriculture such as enjoyed by Iowa farmers brings a relatively high monetary return to them. The prosperity of the farm firm is likely to be reflected in the level of living of the families. About one-third of the employed workers are in agriculture.¹ A large proportion of the remainder work in industries and services related to agriculture. Farms include 96.2 percent of the land area of the state.

¹Unless otherwise noted, the data cited in this section are either quoted or computed from the 1945 and 1950 U. S. Censuses of Agriculture.
Although commercial, Iowa farms are family size rather than large scale. In fact, during 1949 only 40,000 persons, or less than one-fifth of a person per farm, were classified as hired farm workers. Through the use of highly mechanized equipment, increasingly efficient farming methods and improved varieties of crops and breeds of livestock, the farms produce more food each year than can be consumed by the producing family in many years.

In 1945, 10 percent of the farms reported a gross value of products of $5,000 or more per farm. The per acre value of land and buildings was $105, and the per farm reporting value of implements and machinery was $1,868.

The level of living index of farm operator families is an indicator of the prosperity of Iowa farmers. In 1945, the index was 162 as compared to a national average of 100.\(^1\) Five years previous the index was 133.

While on an overall basis the level of living of farm families was high, an examination of the indexes by townships showed a range from 60 to 228.\(^2\) Thus, the families in the high township, on an

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Folsom used Hagood's formula for constructing county indexes to construct indexes for townships. The formula is given in Hagood, Farm operator family level of living indexes for counties of the United States, 1940 and 1945.
average, had a level of living index nearly four times as large as those in the low township.

Iowa farm families when arrayed with those of the nation on any continuum such as poor-prosperous or subsistence-commercial, approximate the prosperous, commercial poles of the continuums.
II. THE FIELD OF LEVEL OF LIVING

A. Introduction

Before entering the methodological phase of this study, it is appropriate to sketch briefly the historical development of level of living studies, to obtain an understanding of what is meant by the term "level of living", to discuss scale analysis as applied to level of living and to elaborate on the measuring of areal differences in levels of living.

B. Historical Development of Level of Living Studies

Several efforts have been made to trace the development of level of living studies here and abroad. The most comprehensive was undertaken by Williams and Zimmerman under the sponsorship of the Social Science Research Council, the United States Department of Agriculture and the Institute of Pacific Relations. They concentrated on an analysis of materials and methods used in 1500 studies of family living in the United States and 51 other countries.¹

Studies which they selected for review presented data on either total money income or total money expenditures of individual families.

¹Williams and Zimmerman, op. cit.
The authors encountered much divergence in the kinds of data presented. Terms used often carried local meaning, and sometimes defied precise classification.

The first studies made in the United States were for the years 1816 - 1817, and the second for 1835. The analysis of household accounts kept by an individual farm family for its own information. No other analyses were found until 1869. From 1869 to 1900, 109 studies were made of families of wage earners, low salaried workers, and small proprietors in the United States; 60 studies were made between 1900 and 1914; and 24 were made between 1914 and 1919. A total of 18 were made on farm families. From 1919 through 1934 studies of farm families exceeded those made of non-farm families by more than two to one, representing a rather significant shift in concern to this occupational sector of the population.

Comparative welfare seemed to keynote many of the earlier studies. Interest was shown in comparing levels of living at home and abroad. Legislation relative to tariffs in the latter part of the 19th century often was conditioned by the findings in such studies. In the early 1900's most of the studies were designed to help solve problems of factory hours and wages.

Periods of rising prices, with maladjustments between purchasing power of customary wages and cost of the customary levels of living

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1 Ibid., p. 7.
2 Ibid., p. 7.
resulted in many studies of living expenditures. For example, the United States Bureau of Labor Statistics study made in 1901 of 25,140 families was a result of the rise in prices in 1900.\textsuperscript{1} World War I ushered in a number of studies of expenditures, perhaps the most notable being that by the U. S. Bureau of Labor Statistics in 1918-1919 covering 12,096 white families and 741 colored families.\textsuperscript{2}

Warren's 1909 study of farm families in Livingston County, New York in which he attempted to attach a monetary value to the whole range of family living was the first of its kind in the United States.\textsuperscript{3} This study plus that of Funk's done in 1913, by the Office of Farm Management of the Bureau of Plant Industry, gave stimulus to research which attempted to measure level of living in terms of income and expenditures.\textsuperscript{4} It was not until the early 1920's that state agricultural experiment stations became interested in any large scale analyses of farm family levels of living. E. L.


\textsuperscript{4}Funk, W. C. What the farm contributes directly to the farmers' living. U. S. Dept. of Agr. Farmers' Bul. 635. 1914.
Kirkpatrick, then with the Bureau of Agricultural Economics, initiated a project in the period 1922–1924 which resulted in securing data on 2,886 white families in 11 states.\(^1\) Comparisons were made between the families of owners, tenants and hired men, and between these families and other farmers' and workingmen's families. Data from this and the preliminary reports prepared by Kirkpatrick and one or more representatives in each of the states were used widely as representative of the situation of farm families in the United States. The Bureau of Agricultural Economics index of the prices of commodities farmers buy for family use was constructed in part from information obtained by this study. Kirkpatrick, while not the first researcher, perhaps more than any other single individual contributed at that time to the interest in the welfare of the farm population.

The studies briefly surveyed showed that nowhere had there been any concerted attempt to include enough communities or contiguous areas to give an adequate picture of the spatial variation in levels of living.

The depression period of the 1930's contributed appreciably to the growing awareness of the intricate complex of population, environment and culture. More than before, researchers began to

realize that no one part could be understood except in relation to the whole. Odum and Moore insisted that a regional approach was basic to the understanding of human affairs. Ten years earlier Mukerjee emphasized the need for studying the regional complex as an inseparable whole. Other studies that carried forward the regional and sub-regional approaches were mentioned in Chapter I.

C. Level of Living Defined

Out of the vast array of level of living studies, a number of definitions of "level of living" have been proposed. With the advent of multiple factor scales and indexes, the term "level of living" took on a more complex connotation than that of merely a summation of all expenditures. Several of the currently prevailing definitions will be presented.

Williams and Zimmerman spoke of level of living as a summary term when comparing the content of one living with another, or with a standard, or when generalizing about the content of living of a group. They used the term "standard of living" to "mean an ideal or norm of consumption".

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1 Odum and Moore, op. cit.
3 Williams and Zimmerman, op. cit., p. 4.
4 Ibid., p. 4.
Mangus and Cottam stated that a level of living of a family

... sometimes referred to as its scale of living, plane of living, or socio-economic status consists of the nature and quantity of goods and services possessed at a given time or consumed during a given period. Under the concept, level of living, are included materially measurable possessions of all sorts: household conveniences, land and business accessories, income, health, education, and a host of related acquisitions which imply activities that are directed toward the satisfaction of biological requirements and cultural and social needs. ... The standard of living implies a group way of life that brings a maximum amount of satisfaction to each individual member of the group. ... Level of living is ... a segment of standard of living.1

Leagans had this to say about level of living:

In the sense in which the term is most frequently used, "level of living" refers to the actual expenditures of individuals or family groups. It implies the creation of a composite picture of prevailing choice patterns of economic goods and services consumed by an individual or family. It is the status which a person or family occupies with reference to the ownership and consumption of prevalent types of goods and services. The level of living, therefore, is essentially the summation of all the consumption choices made by the members of a given family.2

Longmore and Taylor pointed out that

... an established level of living consists of considerably more than ... necessities. It is a complex or cluster of habits or standards which are considered by the family to be fairly rigid social or cultural requirements. Thus, to have not mere shelter but housing which meets acceptable standards; not merely to be clad, even well clad, but to be acceptably well dressed; to educate one's children, and to

1Mangus and Cottam, op. cit., p. 9.
participate in institutional, community and recreational activities are social and cultural desires which are relatively imperious. Physical necessities plus these culturally or socially stimulated desires apparently tend to make farm families resist any sharp decline in their accustomed levels of living.  

In the development of the level of living indexes for farm families by counties in the United States, Hagood and Ducoff used the following working concept of level of living, as

..., the level of current consumption or utilization of goods and services, with services being broadly interpreted to include both publicly furnished and privately secured services which contribute to well-being or provide satisfactions.

Then to focus attention on the distinction between a level of consumption and income they said,

The level of consumption and utilization of goods and services during a specified period of time is not identical with an income or expenditure level since consumption expenditures may exceed or fall short of the income in the specified period, and since the utility obtained from goods and services currently used is by no means strictly identifiable with current consumption expenditures. Furthermore, a given expenditure level may represent for different families or individuals widely different quantities of goods and services consumed which are not purchased, and differences in budget management. Hence a measure of level of living is not merely a substitute for a measure of income or family living expenditures, since the concept, although closely related, is clearly differentiated.

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3. Ibid., p. 78.
All of the foregoing definitions are in agreement on the consumption of material goods and services as a measure of level of living. With respect to the non-material elements, some of the definitions broadly interpret level of living to include all activities directed toward the satisfaction of cultural and social needs. Other definitions are more modest. Inasmuch as this is a methodological study and use is made of township indexes constructed with the Hagood formula, interpretations will be in the general framework of the Hagood and Ducoff definition.

D. Use of Scales in Analyses of Levels of Living

An important trend in the social sciences during the past few decades has been the increasing development and use of measuring instruments, commonly referred to as scales. A number of scales have been constructed and used to measure level of living, standard of living and socio-economic status. While definitions of these three terms are not identical, from a statistical point of view, the same type of scale or index is used to measure these social phenomena.¹

¹The terms "scale" and "index" in much of the literature are used interchangeably. A scale however is usually used to indicate position on a continuum while an index is usually used to measure the departure from or the relative relationship to some norm or average.
Perhaps the best known of the early scales was that of Ernst Engel developed in 1895. In setting up his scale, Engel employed a unit called quet in honor of Quetelet. This unit was based on the average consumption of an infant. With the passing of each year of growth, .10 quets were added up to 25 years for men and 20 years for women. While this was an arbitrarily determined unit, it served to stimulate the development of more scientific units. As the result of his researches, Engel evolved his law of consumption for which he is best known. Zimmerman stated the law in the following terms: "The proportion of the outgo used for food, other things being equal, is the best measure of the material standard of a population."2

Single factor indexes of levels of living were commonly used in earlier attempts at stratifying farm families. An elaborate discussion of this may be found in Sewell's study in Oklahoma.3 Tenure and occupation were the most frequent types of single factor indexes used. Sewell maintained, "At best they [single factor indexes] differentiate only between extreme levels."4

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2 Ibid., p. 39.
3 Sewell, op. cit.
4 Ibid., p. 9.
Of income as a single factor he said that "... when used without
due consideration of size, age, and sex composition of the family,
it becomes an almost useless index."¹

Other reasons dictate the unacceptability of income alone
as an index of level of living. Many studies have resorted to a
single year income figure rather than an average for a series of
years. A "normal" year of income cannot be ascertained. Wide
variation exists between gross and net income. Some enterprises
on farms yield a large income, but involve a large expense and
small net return. Others yield a small gross income, but, relatively
speaking, a large net income. Gross income data tend to exagger-
ate the real difference between the living levels of families on
different types of farms, or between years where a shift in enter-
prises takes place. If it is assumed that changes in living levels
are, in part, the delayed function of changes in income, researchers
using income as a crude measure of level of living should use no
less than the average of a series of years immediately preceding
that for which an index is being obtained.

In 1923 E. L. Kirkpatrick set up a series of cost-consumption
unit scales for farm families.² These included separate scales for

¹Ibid., p. 9.

²Kirkpatrick, E. L. The standard of life in a typical section
1923.

and Tough, E. G. Comparison of two scales for measur-
1931.
food, clothing, rent, maintenance of health, advancement, personal
goods and furnishings. A weakness of this approach was the lack of
a summary unit or index. Its strength was in the consideration of
a multiple of factors.

A scale that has been used in studies of farm family income
and consumption was one developed by Zimmerman and Black in 1927.
The uniqueness of this scale was that the consuming power for all
goods and services of an adult male 19-60 years of age was considered
to be unity. Twelve age and sex classifications were included,
thus permitting combinations for all kinds of age and sex distrib-
utions within families.

Our present day reliance on multiple-factor indexes dates back
to John R. Commons' use of a dwelling house score card in housing
investigations in 1908. Items on the card included location,
congestion, ventilation, lighting, condition of house, appurten-
ances, sleeping arrangements, number of occupants, and cleanliness.
Though unstandardized and arbitrarily constructed, the scale provided
suggestions for later developments in multiple-factor scale construc-
tion.

Scales by other researchers followed in rapid succession.
Several will be mentioned here. Perry published a Manner of Living

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1 Zimmerman, C. C. and Black, J. D. How Minnesota farm family
incomes are spent: an interpretation of a one year study. Minn.

2 Commons, John R. Standardization of housing investigations.
Index in 1913. Arbitrary weights were assigned to each of several articles used in each of the four most important rooms in the house. An index was computed by dividing the sum of the ratings by some pre-established standard. This was probably the first index to include actual home conditions.

Mumford, Thaden and Spurway designed a score card to study farm family living. Arbitrary weights were assigned to each of its six parts: home equipment, arrangement and surroundings; family practices; schooling, reading and extension affiliations; art and recreational activities; organization and institutional affiliations and attendance; and leadership and civic responsibility. Because the score card was not standardized, its value was open to question. However, it appeared to have relatively good balance between material and non-material elements.

Standardization of scales for urban families began about 1925, and helped provide some of the basis for the later construction of a rural scale. Chapman and Sims administered the first standardized scale to high school students. The scale was designed to cover


occupation and education of parents, reading matter in the home, and possession of automobile, telephone and radio. This was one of the first efforts at limiting the number of items to a manageable size, and at the same time demonstrating the advantage of a multiple-factor scale.

Chapin began work about 1928 on the development of what he called a Social Status Scale.¹ Emphasizing material possessions only, the scale is brief, relatively simple and well standardized for determining the socio-economic status of urban families.

A. M. Leahy, also in Minnesota, designed the Home Status Index to measure the material elements in the home environment.² Fifty items were included, grouped into six categories as follows: children's facilities; economic status; cultural status; sociality; occupational status; and educational status. Weights were assigned statistically. This index is regarded as one of the better standardized instruments for measuring level of living.

With this background on urban families, Sewell constructed and standardized a scale in 1940 for use on unbroken rural farm families.³ Thirty-six out of more than 123 material and non-material

---

¹Chapin, F. Stuart. The measurement of social status. Minneapolis, Univ. of Minn. Press. 1933.
²Leahy, A. M. The measurement of urban home environment. Minneapolis, Univ. of Minn. Press. 1936.
³Sewell, op. cit.
items tested were retained for construction of the scale. Fifteen items represented the material possessions component of the scale; 13, the cultural possessions component; and eight, the social participation component. The scale has been widely used in various sociological studies for socio-economic stratification of farm families.

This brief survey of the development of the more important scaling techniques used to measure socio-economic status showed that: (1) most of the early attempts at measuring socio-economic status were of the single factor type; and, (2) as an outgrowth of experience with the single-factor indexes and their limitations, social scientists turned to the development of multiple factor scales. Improved statistical techniques have contributed markedly to the standardization of such scales.

Practically all of the above mentioned scales lack adaptability for measurement of living levels over large areas except at great expense. Most have been used to arrive at a general statement of the level of consumption, rather than trying to arrive at spatial areas in which living levels follow a similar pattern. While the tremendous amount of research done with the above scales has been of immeasurable value and has contributed to explorations on an areal basis, it would appear logical that measurement on an areal basis should precede or be supplemented by the scales of more limited application. The combination of the two approaches would provide
an existent pattern or configuration of level of living differentials within which the detailed and specific aspects of a study could be undertaken. In this manner a specific frame of reference could be provided within which stated hypotheses could be tested.

Raper and Taylor have made reference to this:

The concept of the cultural area or region is of basic importance to the social scientist, and to the rural sociologist especially, for it provides a means whereby the spatial aspects of society can be broken down into broadly and relatively homogeneous locality units. This type of delineation makes it possible for scientists to deal with the separate areas as segments of a unified whole — a type of analysis greatly needed to supplement the economic and population analyses that have been done on these same geographic bases, and to supplement and enrich the findings of specific studies that have been made of such subjects as levels of living, leadership, delinquency, family organization, and youth participation in group activities. Studies of cultural areas and of specific subject matter fields will supplement each other in many important ways. In fact there is a dawning realization that neither can be done adequately without the other.¹

E. Measuring Areal Differences in Levels of Living

One of the first attempts to determine differences in farm family living levels among rural areas was in Ohio by Lively and Almack in ¹9³⁸.²


²Lively, C. E. and Almack, R. B. op. cit.
The study was based on census and other data available by counties. On the basis of intercorrelation analysis six components demonstrating discriminating capacity on a county basis were selected: average value of farm dwelling; percentage of farms reporting radios; percentage of farms reporting telephones; percentage of farms reporting electricity; percentage of farms reporting running water and percentage of farms reporting automobiles. One advantage of this index was that it provided an easily applicable method for determining levels of living by counties for the rural population in Ohio.

Mangus used a similar set of components for the level of living variable which was one of seven he used for delineating the rural regions of the United States. The components were: average value of the farm dwelling; the percent of farms having automobiles; the percent of farms having electric lights; the percent having running water piped in the house; the percent having telephones; and the percent having radios, 1930.

Since the Ohio study, Lively and Gregory have pursued a similar type of study in Missouri. Their procedure involved three steps: (1) the selection and weighting of variables upon which the delineation was to be based; (2) using the variables to delimit the areas; and (3) testing to determine the validity of the work.

1 Mangus, op. cit., p. 79.
Starting out with a large number of variables, Lively and Gregory found through correlation analysis of all possible combinations that two major indices set a pattern around which the rest could be grouped. By superimposing the regional pattern of one index on that of another, it was then possible to delimit sub-areas, i.e. homogeneous groups of counties. The authors maintain that while the technique worked in Missouri there is, as yet, no assurance that it will be satisfactory in other states or areas. Once having delineated the rural social areas, the authors found that over time the boundaries changed only slightly. Special researches in sociological subjects at the University of Missouri have used the areas.

While the Ohio and Missouri studies represent the earliest work in rural social area delineations, and that of Mangus the first to delineate rural regions; Goodrich and associates constructed a plane of living index for total county populations.¹ Rural and urban populations were not treated separately. Criteria used were: income tax returns; number of residence telephones in use; and, number of families who reported radio sets. The authors made no claim for the validity of their index, only that this method had produced in broad outlines some knowledge of the general welfare of the people of the nation. It was not adapted to very exacting delineations.

The Hagood indexes referred to earlier, and which provide the working basis for this study, were the latest developed.\(^1\) They were constructed as "general purpose" indexes to be used chiefly in delineation of areas or regions for both administrative and research purposes, and for analyses of the relationships of "level of living" to various social and economic phenomena.

The 1940 indexes consisted of five components: (1) percentage of occupied dwelling units with 1.5 or fewer persons per room; (2) percentage of dwelling units with radio; (3) percentage of farms with gross income of more than $600; (4) percentage of farms reporting autos of 1936 or later models, and (5) median grade of school completed by persons 25 years of age and over. The five components were selected and weighted by the factor analysis method.\(^2\)

The 1945 indexes consisted of four components: (1) percentage of farms with electricity in farm dwelling, 1945; (2) percentage of farms with telephone in farm dwelling, 1945; (3) percentage of farms with automobiles, 1945; and (4) mean value of products sold or traded per farm reporting, 1944.\(^3\)

---


Hagood presented a short description of the method she used in the construction of the 1945 index formula.

Construction of the formula for combining information on items in the indexes involved the obtaining of weights through component analysis of the intercorrelations among the four items. This method of obtaining weights assumes that the items should be combined in such a way as to provide a composite measure of the highest factor they have in common. This is the factor which can best be measured by the given items and it is assumed to represent an approximation to "level of living."

To expedite the construction of the indexes, the preliminary work was limited to a national sample of 196 counties. With certain supplementary counties, this was used by the Bureau of the Census for early processing of the results from the 1945 Census of Agriculture to obtain national and regional estimates before complete tabulations were available. The stages in development of the index formula from the correlations for this sample of counties is shown in the following table. The formula for 1945 is as follows:

\[ 1945 \text{ Index} = 0.538X_1 + 0.603X_2 + 0.617X_3 + 0.460X_4, \]

with the subscripts of the items referring to the identification numbers used in the following table.

One modification was required in the formula for use in computing comparable index values for 1940. To allow for the higher purchasing power of the farmers' dollar in 1939 than in 1944, the average value of products sold or traded as reported for 1944 could have been increased by 37.1 percent before applying the 1945 index formula. For computing purposes it was simpler to multiply the weight for this item, \( X_1 \), by 1.371. This results in the following formula for 1940 data:

\[ 1940 \text{ Index} = 0.538X_1 + 0.603X_2 + 0.617X_3 + 0.631X_4, \]

with the subscripts of the items referring to the identification numbers used in the following table.
Stages in development of index formula from intercorrelations of four items related to farm operator level of living, sample of 196 counties, 1945

<table>
<thead>
<tr>
<th>Identification of item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlations of items with each other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>.622</td>
<td>.715</td>
<td>.450</td>
</tr>
<tr>
<td>2</td>
<td>.622</td>
<td></td>
<td>.794</td>
<td>.489</td>
</tr>
<tr>
<td>3</td>
<td>.715</td>
<td>.794</td>
<td></td>
<td>.537</td>
</tr>
<tr>
<td>4</td>
<td>.450</td>
<td>.489</td>
<td>.537</td>
<td></td>
</tr>
</tbody>
</table>

Correlations of items with principal component

| Correlations of items with principal component |
| .836 | .877 | .920 | .713 |

Standard deviations of items

| Standard deviations of items |
| 26.0 | 24.3 | 24.9 | 26.0 |

Correlations of items with principal components divided by standard deviations of items

| Correlations of items with principal components divided by standard deviations of items |
| .0322 | .0361 | .0369 | .0275 |

Weight for each item in index formula

(Weights coded by multiplying preceding line times 10.71 to make the U.S. mean equal 100 and zero value on all items equal zero.)

| Weight for each item in index formula |
| .538 | .603 | .617 | .460 |

1/ Identification of items:

1 = Percentage of farms with electricity in farm dwelling, 1945.
2 = Percentage of farms with telephone in farm dwelling, 1945.
3 = Percentage of farms with automobiles, 1945.
4 = Mean value of products sold or traded per farm reporting, 1944 (in hundreds of dollars).1

1 Ibid., p. 40-41.
While considerable use has been made of the group type of indexes, little has been written on the nature of these indexes, the "content" of them, or on the concept of level of living as applied to a group average.\(^1\) Hagood and Ducoff in attempting to indicate what a level of living index measures pointed out:

\[
\ldots \text{(1) that an index is not a direct measure of the actual level of living, but only an indicant of it; (2) that such an indicant for a county is not of the absolute degree of attainment of some external standard, but is expressed in relation to the corresponding degree of attainment for a defined group (e.g., the average of all counties); (3) that the description of level of living relates only to the average level attained by the specified residence class of the county, and not to variations in the level of living present among the individual families or persons.}\]

Clearly an index made up of a small number of components indicating level of living for a population such as that of a county or township is not satisfactory for use in measuring the level of living of an individual or of a single family. The unique deviations in consumption patterns of an individual necessitate a scale with sufficient components to produce a reliable indication of the level of living of that individual. Those who have constructed scales for measuring level of living of families or individuals found that reliability was usually lost when the number of items was reduced.

\(^1\) Exceptions to this include: McKain, Walter C., Jr. The concept of plane of living and the construction of a plane of living index. \(\text{Rur. Soc. 4:} 337-343.\) 1939.

Hagood and Ducoff, \(\text{op. cit.}, \) p. 78-84.

\(^2\) Ibid., p. 79.
It does not necessarily follow, however, that indexes should consist of large numbers of components. Those who construct indexes usually are limited by the necessity of selecting such components as are prevalent for the entire nation or other large area and which have attained general acceptance.

Most indexes have relied rather heavily on such items as percent of farm families having radios, telephones, electricity, automobile and running water in the home. As increasing proportions of farm families acquire these items, other components will have to be used in index construction in order that areal differences in levels of living may be reliably determined. Suggested types of components might consist of: (1) a record of income and of expenditures for family living for every rural-farm family in the nation; (2) a record of family produced goods and services; (3) some kind of an inventory of goods used in family living; (4) an inventory of publicly supplied goods and services that were consumed; and (5) extent of social participation. Basically, this would amount to a beginning and ending inventory for all carryover goods and services plus an itemization of all between inventory consumption and participation. Construction of an index with these suggested components will have to await a more complete enumeration of such information by the census or some other agency. As public interest in areal level of living differentials grows, an increasing body of such information may be expected to become available.
Summarily, the study of areal variations in levels of living represents one phase of an ecological approach to the study of rural social phenomena. A more complete approach suggests the necessity of examining social phenomena in terms of all relevant ecological contexts for an adequate understanding of their significance. Once the coexistence of a number of ecological areas of influence with reference to any population has been demonstrated, it would seem to be a reasonable assumption that specific rural problems could be attacked within the framework of the appropriate ecological structure. While this study is not on problems of the areas per se, it is concerned with the ecology of levels of living in Iowa.
III. METHODOLOGY AND PROCEDURE

A. Introduction

Discussion in Chapters I and II has sketched in some detail the attention that has been given to the problem of ascertaining levels of living. The historical and contemporary perspective for the research was described. The paucity of measures and the small amount of research of level of living on an areal basis were indicated.

The basic methodology and procedure used in this dissertation are formulated, and the various techniques of analysis are briefly described in this chapter. Sources of data and their quantitative and qualitative characteristics are presented. Such a digression is necessary, since the investigation is methodological and exploratory and, in some cases, lacks the preciseness of straight-forward statistical analysis. No effort is made to explore the interesting theoretical considerations, nor to consider the dialectics on some of the methods.

B. Selection of Techniques of Analysis

The problem in this study is an attempt to develop and/or to apply some alternative methods and techniques which will raise the level of understanding of differentials in levels of living and
related factors in Iowa. After a critical review of recent level of living studies and through an awareness of the many problems of areal planning, this research seemed to offer fruitful possibilities.

The problem was selected because: (1) previous investigators had pointed up the crudity of using states, and even counties, as units for delineating farm family levels of living, suggesting that units as small or smaller than a township would be more satisfactory; (2) the validity and usefulness of the Hagood level of living indexes generally has been accepted; (3) the formula used in developing the Hagood indexes could be applied with equal facility to similar data on a township basis; and, (4) researchers in a number of states are using the township indexes to good advantage in planning and executing researches on areal bases, and action agencies have used the information for planning programs.

Methods and techniques of analysis proceeded from an examination of farm family level of living in the usual manner of simple geographic variation and statistical variation to the more intensive analyses using analysis of variance, simple correlation, multiple correlation and multiple regression to determine not only extent of variation in level of living, but relationship of level of living to selected social and economic variables for the state as a whole, and to determine the collective and individual predictive value of the variables on level of living. In general, similar analyses were carried out by type of farming areas, by soil
association areas, and by homogeneous and non-homogeneous level of living areas. The homogeneous and non-homogeneous areas were delineated on the basis of contiguity of townships having uniform level of living indexes. Finally, the ecology of farm family level of living and of selected social and economic variables was ascertained by determining the extent to which the variables for each township ranked in relationship to level of living. Results were presented statistically and graphically. As each method and technique is unfolded and results indicated, implications are stated. The results of the research are then summarized.

C. Sources of Data

Many types of information relative to social and economic factors found on a county basis were not obtainable for townships except in unpublished form. For this study, arrangements were made for obtaining information in whatever forms available. Below is a listing of the types of information compiled, together with their sources. Both published and unpublished data were utilized.

1. Farm operator family level of living index, 1945 - compiled by Josiah C. Folsom by using for townships the 1945 formula developed for counties, published in Hagood, Farm operator family level of living indexes for counties of the United States, 1940 and 1945, p. 40.  

1 Folsom, Josiah C., op. cit.


4. Mechanization index per 100 acres, 1945 - computed from unpublished data in the files of the Iowa Crop and Livestock Reporting Service. To compute the index, each tractor, because of its more frequent use throughout the year was assigned a value of 3; combines, corn pickers, and hay balers each a value of 1. The resulting total was divided into the hundreds of acres in farms in the township for the index value.

5. Crop productivity index, 1940-1944 - as computed by the Iowa Crop and Livestock Reporting Service represents the total production in pounds of all grains and seeds (including corn, oats, soybeans, wheat, barley, rye, flaxseed, popcorn, clover, alfalfa, and timothy) for each township for the five year period. An index of 100 was set to represent the state average for the five year period.

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1 Iowa Crop and Livestock Reporting Service. Iowa assessors annual farm census, township record, 1945. (Unpublished data). Des Moines, Ia., Dept. of Agr.

2 Ibid.

3 Ibid.

6. Corn yield, bushels per acre, 1940-1944 - obtained from Iowa Department of Agriculture Bul. 925.¹

7. Value of implements and machinery per 100 acres, 1945 - computed from unpublished data by minor civil divisions on file U. S. Bureau of the Census, Agriculture Division.²

8. Value of land and buildings per acre, 1945 - computed from unpublished data by minor civil divisions on file U. S. Bureau of the Census, Agriculture Division.³

9. Percent rural farm population is of total population, 1940 - computed from data from the U. S. Census of Population, 1940.⁴

10. Percent 1940 population is of the 1900 population - computed from total township population from U. S. Census of Population for the decennial years 1900 and 1940.⁵ The decennial year 1900 was used as the base year with an index of 100. Values given for 1940 represent the percent the 1940 population is of the 1900 population.

¹Ibid., Fig. 2.

²U. S. Bureau of the Census, Agriculture Division. Value of implements and machinery by townships, 1945. (Unpublished data.)


11. Percent of population foreign born and of foreign or mixed parentage, 1930 - computed from U. S. Census of Population, 1930. Similar information for 1940 was not available.

12. Township participation rating score, 1938 - represents a measure of interests and participation of local people and the use of local volunteer leaders in county extension work during 1938. Participation ratings were from the Standard Farm Bureau Score Card covering: (1) local interest and support; (2) leadership; (3) activities; and, (4) results accomplished.

13. Type of farming areas - obtained from Iowa Agricultural Extension Service, Background of Iowa Agriculture.

14. Principal soil association areas - basic information obtained from Riecken and Smith, Principal upland soils of Iowa. Slight modifications were made in the soil associations map shown opposite p. 2 in the above publication for this study. Persons assisting in these changes in addition to the above authors were A. R. Amndahl and F. L. Thompson, all staff members of Iowa State College Agronomy Department.

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²Iowa Agricultural Extension Service. Information on township participation rating score, 1938. (Unpublished.) Ames.


The result of a given stage of the plane geometry and arithmetic to produce, the order products in which the product of a given number of units of a given product is expressed and evaluated. Some measures of the product or the product measures of the variable in question; in other cases some measures of the quantities involved are used for the determination of the product. In general, the data of the investigation were quantitatively. In the process of the quantitatively and quantitatively expression of the connections and relations of the quantities involved, the use of tables and graphs is appropriate. Certain of the types of computations indicated above were
Township participation rating, soil association areas and type farming areas, while supported and often based on quantitative data, were based in part on judgment. To this extent they were of a more qualitative nature than those factors based on enumerated data only.

While the following analyses largely are statistical in nature, the investigator does not insist that any term or concept, operationally defined, can be handled in a statistical manner. The issue of certain sociological factors being statistically measured is pertinent. Thus, if level of living is a sociological factor, to what extent is the index a measure of certain social behavior or of human interrelationships and satisfactions? Which is more significant the level as indicated by the index, or the quality of living? A family may possess all of the material comforts of life, yet not know how to use them in a manner that will maximize human satisfaction. The qualitative aspects of a given level of living may be only inferred from the statistics that indicate a given level. Because the concern here is with group phenomena, the average level of living in a given township or area represents a smoothing out of the wide family to family or person to person variations. To the extent that the level of living index is viewed as an average, it may be interpreted with a high degree of confidence.
IV. FARM FAMILY LEVEL OF LIVING IN IOWA

A. Introduction

Even though in a generalized sense Iowa, as a state, is a segment of a larger universe of similarities, a number of dissimilarities exist within its borders. This chapter is concerned with the identification of similarities and dissimilarities in levels of living of farm families. The descriptive and statistical treatment was designed to present an overall view of the situation in the state; to determine the relationship of the several variables to level of living; to determine the usefulness of these variables for predicting level of living; and to provide the background for the analyses in the succeeding chapters.

The level of living measured by the indexes used in this study is a composite of many characteristics, some of them measurable, some perhaps not—which tend to be present when and to the degree that the index items are present and reflect such characteristics.

The indexes were developed for townships through use of the formula for the county indexes as discussed in Chapter III. The average of all township indexes was 1641, that of county indexes was 162. A slight departure in the preparation of the two indexes, however, should be noted. Data for preparation of the county indexes
In 1947, the average score in the United States was 100. The average for the nation, the mean for the United States was 100. The range by committee with indexes of 70 and 175, respectively, ranked higher in the committee for the state was 10%. Only Connecticut and New Jersey.

In 1947, the mean farm family index was drawn at the level of an average index for all

2. CORPORATION IN TERMS OF INCOME - GEOGRAPHIC

She have been on the basis of 5,750 families varied.

The sense of general position, thus, all committees and the are.

Fewer than 50 farms outside incorporated areas were combined with

In any townships where.

Income for 23 of the encompass.

22.6, with the smallest number of farms outside incorporated areas

exceeded them.

Excluded farms in incorporated places, that for townships indexes
LEVEL OF LIVING INDEX

- UNDER 120
- 120-139
- 140-159
- 160-179
- 180-199
- 200 & OVER

* OMITTED FROM CLASSIFICATION

Fig. 1. Farm family level of living by townships, Iowa, 1945.
representing about one-fifth of the townships in the state, were located in the south, west and northeast parts of the state. At the other extreme the two highest index groups, again representing approximately one-fifth of the townships, extended from southeast Iowa to northwest Iowa with some scattering of high index townships in northeast Iowa and in an area extending from the west north central to the west southwest parts of the state.

In general, the townships in the lowest fifth were adjacent to those of the next highest fifth, while those in the next to the highest fifth were adjacent to the highest group. The fifth of the townships represented by the index level of 140-159 appeared to have the least propensity for contiguity or tendency to cluster of any of the index levels of townships.

The area bounded on the northeast by the lower reaches of the Wapsipinicon river and on the southwest by the lower reaches of the Des Moines and Middle Raccoon rivers includes most of the townships in the state that show high farm family level of living indexes, Figure 2. In broad outlines, this encompasses much of the East Central Meat and the North Central Grain type of farming areas. See Figure 7.

Levels of living were found to vary widely, often within small areas. For example, ranges from the lowest to the highest level of living index intervals were found in several of the counties. A tabulation of counties by ranges between high and low township farm
Fig. 2. Farm family level of living by townships, as bounded by the Wapsipinicon river and the Des Moines and the Middle Raccoon rivers, Iowa.
family level of living index intervals is given in Table 1 and shown in Figure 3.

Counties with the lowest ranges between level of living index intervals were located mainly in southern Iowa; those by the highest ranges between intervals in west, northwest Iowa. Only seven counties had ranges of one interval; 35 of two intervals; 37 of three intervals; 16 of four intervals; and four of five intervals. Those counties which showed interval ranges of three often clustered in small groups throughout the state, as likewise did the more homogeneous counties with ranges of two intervals. While considerable homogeneity may have existed within a county, certain of the townships in that county may have been part of a rather heterogeneous area that cut across county lines; or some townships in an heterogeneous county may have been part of a homogeneous level of living area. For these reasons, townships appeared to more effectively discriminate between different living levels among the farm families of the state, and therefore were superior to county level of living indexes for the identification of homogeneous or heterogeneous level of living areas.

C. Variations in Levels of Living - Statistical

Wide variations in levels of living of farm families by townships in Iowa has been indicated. Grouped into level of living index intervals the following distribution of townships occurred.
Table 1. Iowa counties classified by range in township farm family level of living index intervals, 1945

<table>
<thead>
<tr>
<th>Lowest level of living index interval</th>
<th>Under 120</th>
<th>120-139</th>
<th>140-159</th>
<th>160-179</th>
<th>180-199</th>
<th>200 and over</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 120</td>
<td>-</td>
<td>3</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>4</td>
<td>32</td>
</tr>
<tr>
<td>120-139</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>15</td>
<td>9</td>
<td>26</td>
</tr>
<tr>
<td>140-159</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>13</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>160-179</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>180-199</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>200 and over</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>3</td>
<td>10</td>
<td>12</td>
<td>35</td>
<td>39</td>
<td>99</td>
</tr>
</tbody>
</table>
Fig. 3. Iowa counties by range in township farm family level of living index intervals.

Range in number of index intervals

- Lightest shade = 1
- Second lightest = 2
- Third lightest = 3
- Medium = 4
- Darks = 5
percent of the aggregate. It may be hypothesized that the extent to
aggregate of the index, using the upper 20 percent accounted for 72
20 percent of the communities accounted for only 12 percent of the
ness of the existing distribution of index, for example, the lower
curve departed from the straight line indicating the degree of uneven-
A straight line instead of a curve, the extent to which the amount
be represented
in a normal distribution or level of living index may be represented
Figure 5 provides another useful device for illustrating how
mean, median, and mode coincide.
the median were less than the mode. In a normal distribution, the
when in the past the number shown is close to the mode. Both the mean and
sloping in the curve, the curve, as did the distribution of the
in the preparation of the geometric distribution of the 1926
repeated.
uniform distribution in levels of living, a uniform scale interval was
uniform distribution decreased. Since the focus of this study was on
higher intercepts decreased. Since the focus of this study was on
lower intercepts would have had to be encreased and the range in the
opinions a constant, existence of separate distributions were in the
there was a definite concentration within the higher intercepts. To

<table>
<thead>
<tr>
<th>Level of Living Index Inference</th>
<th>202</th>
<th>199-202</th>
<th>196-199</th>
<th>190-196</th>
<th>180-190</th>
<th>160-180</th>
<th>120-160</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over</td>
<td>111</td>
<td>376</td>
<td>376</td>
<td>936</td>
<td>1128</td>
<td>1812</td>
<td>2080</td>
</tr>
<tr>
<td>Under</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
which the curve deviated from the straight line, or as in Figure 4 the extent of skewness to the left, is an indicator of a similar type of distribution of the physical, economic and social variables that condition the level of living of Iowa families. That is, assuming a normal distribution of each of the variables which condition level of living, a straight line distribution of the level of living indexes could be expected.

Table 2. Cumulative distribution of the total of level of living indexes by percentage distribution of townships

<table>
<thead>
<tr>
<th>Percent of townships</th>
<th>Percent aggregate index is of total aggregate index</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>6.8</td>
</tr>
<tr>
<td>20</td>
<td>15.0</td>
</tr>
<tr>
<td>30</td>
<td>23.9</td>
</tr>
<tr>
<td>40</td>
<td>33.3</td>
</tr>
<tr>
<td>50</td>
<td>43.3</td>
</tr>
<tr>
<td>60</td>
<td>53.7</td>
</tr>
<tr>
<td>70</td>
<td>64.5</td>
</tr>
<tr>
<td>80</td>
<td>75.7</td>
</tr>
<tr>
<td>90</td>
<td>87.5</td>
</tr>
<tr>
<td>100</td>
<td>100.0</td>
</tr>
</tbody>
</table>

D. Change in Levels of Living, 1940-1945

Time series data by townships covering a large number of years would make possible an analysis of dynamics of level of living. Data on change in level of living for this study was limited to that for Iowa counties for the period 1940 to 1945.1 During the five year

1 As of this writing, no other indexes of comparable nature are available by counties for any other years.
period, farm families of Iowa experienced a 22 percent increase in
level of living. All counties in the United States showed an
average increase of 25 percent. By counties the percentage increases
in Iowa ranged from 11 to 39 percent. Despite the range in percentage
improvement, area-wide percentage increases tended to show consid-
erable uniformity throughout the state. This suggests that counties
and areas now low in comparison with other counties and areas of the
state may be expected to continue that same relative positional rela-
tionship into the future. This hypothesis will be supported even
more if indexes covering a larger number of years show the same
positional relationship between the high and low counties and areas.
Assuming that this is the case, marked adjustments of population to
resources must take place in the low counties and areas to effective-
ly raise the families' level of living, or a significant change must
be made in the economy of the counties or areas.

Table 3 shows the numerical distribution of counties by size of
increase in level of living index over the five year period. Within
each numerical increase group, a percentage distribution of counties
is shown to indicate the percentage increase the 1945 index represents
of the 1940 index. In general, the counties gaining least numerically,
gained least percentage-wise. The counties gaining most numerically
gained most percentage-wise.

The following observations may be made from Figure 6 showing the
distribution of counties by farm family level of living for 1940 and
for 1945: (1) improvement in level of living was indicated by the
shift to the right of the curve for 1945 from that of 1940; (2)
and more important, the range between low and high counties in 1945
increased as compared with 1940. The ranges were 91 and 79, respec-
tively. This again indicated that some of the low counties were not

Table 3. Counties classified by numerical and
percentage increase in farm family level
of living indexes, 1940 to 1945

<table>
<thead>
<tr>
<th>Increase in level of living index</th>
<th>Number of counties by percentage increase in level of living index</th>
<th>Average percentage increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 20</td>
<td>10 20-24 25-29 30-34 35-39 Total</td>
<td></td>
</tr>
<tr>
<td>20 - 24</td>
<td>5 5 - - - 10</td>
<td>18.1</td>
</tr>
<tr>
<td>25 - 29</td>
<td>11 13 1 - - 25</td>
<td>20.1</td>
</tr>
<tr>
<td>30 - 34</td>
<td>3 21 13 1 - 38</td>
<td>23.3</td>
</tr>
<tr>
<td>35 - 39</td>
<td>- 2 9 1 1 13</td>
<td>27.2</td>
</tr>
<tr>
<td>40 and over</td>
<td>- - - 3 - 3</td>
<td>31.7</td>
</tr>
</tbody>
</table>

Total 29 41 23 5 1 99 22.0

showing a rate of increase in level of living commensurate with the
rates shown by the high counties. The increase in range shown for the
five year period although not large, if continued accordingly over
a longer period of time, would increase heterogeneity in level of
living of farm families.
E. Relationship of Level of Living to Selected Social and Economic Variables

Much of the evidence presented thus far emphasized the extreme variability of level of living in a state normally thought of as relatively uniform and high in the well-being of the families. Such a viewpoint has resulted from excluding exceptions from view and from dealing mainly in large aggregates with measures of central tendency, with little attention given to evidences of dispersion. The wide variations suggested that families living in areas represented by the two extremes faced widely different problems and decisions on how to allocate their income and resources between those for family living and for farm operating expenses. Families in townships at the lower end of the index array obviously lacked one, two, three and even part or possibly all of the fourth item in the index. At the upper end of the array, families possessed nearly all, or all, of the items. Clearly, the families without electricity also lacked the labor saving and convenience type of equipment associated with electricity. The families without a telephone or an automobile or both were limited in communication facilities and quite probably were not in touch with a wide social universe. Families with a low income were faced with less flexibility in decision making with respect to allocation of income between farm operating and family living expenses. Certain phases of family living probably were curtailed such as health services, recreation, luxury
goods, and formal organization participation.

Since level of living indexes can be classified and the variations isolated, examination of the associational relationship of level of living to a selected group of variables is pertinent. No single variable, but several in interaction account for the differences in the level of living of a group of families. First, the isolation and measurement of the effect or associational relationship of certain of the available variables on level of living will be undertaken here.

The impact of a variable on the level of living of a group of families and its relationship to other variables may very well differ in time and place. That is, causation or association must not be interpreted too narrowly. For example, given low crop productivity, a group of families may be able to continue a high level of living due to finding new sources of income.

First approximations of the relative importance of the 12 variables used in computation of association with level of living were provided by simple variable-by-variable correlation analysis.¹

¹In much of the analysis in the remainder of this study, the statistical treatment was that usually applied to samples of populations. The rationale for using such treatment on the total population is that the population was considered as one obtained from drawing level of living index numbers randomly from an infinite population. That is, the differences inherent in the levels of living throughout the state as indicated by the "F" tests were attributed to factors other than those brought about by sampling fluctuations.
Simple correlations of the independent variables with farm family level of living in order of size of correlation are shown below. Coefficients followed by a double asterisk (**) were significant at the one percent probability level.

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x_6 ) Crop productivity</td>
<td>.78**</td>
</tr>
<tr>
<td>( x_{12} ) Value of land and buildings</td>
<td>.75**</td>
</tr>
<tr>
<td>( x_4 ) Mechanization index</td>
<td>.61**</td>
</tr>
<tr>
<td>( x_{11} ) Value of implements and machinery</td>
<td>.53**</td>
</tr>
<tr>
<td>( x_5 ) Corn yield</td>
<td>.50**</td>
</tr>
<tr>
<td>( x_2 ) Percent tenancy</td>
<td>.44**</td>
</tr>
<tr>
<td>( x_{10} ) Percent foreign born or of mixed parentage</td>
<td>.38**</td>
</tr>
<tr>
<td>( x_9 ) Township participation rating score</td>
<td>.25**</td>
</tr>
<tr>
<td>( x_7 ) Percent 1940 population is of the 1900 population</td>
<td>.20**</td>
</tr>
<tr>
<td>( x_1 ) Size of farm</td>
<td>.11**</td>
</tr>
<tr>
<td>( x_3 ) Number of farm persons per 100 acres</td>
<td>.08**</td>
</tr>
<tr>
<td>( x_8 ) Percent rural farm population</td>
<td>-.05</td>
</tr>
</tbody>
</table>

The correlations as a whole show the degree to which two variates, here level of living paired with each other variate, kept in step as they changed. Plotting of the data indicated a linear relationship between level of living and each of the other variables. Crop productivity when correlated with level of living showed a high coefficient. This was followed by value of land and buildings, the mechanization index, value of implements and machinery and corn yield,
all with correlation coefficients of .50 or above. Other variables showed correlation coefficients of smaller magnitude.

The correlation coefficient of .44 of level of living with percent tenancy is of interest, since it indicates a propensity to greater tenancy in the higher land value and more productive areas of the state.

The association of level of living with percent foreign born or of mixed parentage is also of interest. This may have been the result of the general pattern followed during the state's settlement period by those of foreign birth or of mixed parentage. Generally, the areas settled by those of foreign birth or of mixed parentage were ones which showed the higher levels of living.

The correlation coefficient of .25 of the township participation rating score with level of living was to be expected. Mangus and Cottam made a similar finding in a study of levels of living and social participation in Ohio. While the participation score used in this study was based on limited information on participation of local people, their interest and use of local volunteer leaders in county extension work in 1938, it served as a partial criterion of the role of level of living in participation.

While percent 1940 population is of 1900 population showed a .20 correlation with level of living, population as referred to in this

---

1 Mangus and Cottam, op. cit.
variable included the total, and not farm population alone, to which the level of living indexes apply. However, such a correlation, or even higher, might have been expected, as indicated by the relative increases in total population in the more highly productive and higher level of living areas of the state compared to the less productive areas.

The correlation coefficients obtained between size of farm and number of persons per 100 acres of farm land and level of living were as small as to suggest little or no relationship of the two variables with level of living.

The percent rural farm population is of total population likewise showed practically no correlation with level of living. As a matter of fact, a somewhat higher negative correlation might have been expected. A large, proportionate rural population often is associated with a low level of living, while a small rural population, proportionately speaking, often is associated with a high level of living.

The limitations of the simple variable-by-variable analysis are apparent. Correlation coefficients \((r)\) do not always give an indication of the relative importance of the variables, because the variables may have intercorrelation effects which are not ascertainable from the simple correlation coefficients.

For the analysis of relationships among the 12 independent variables \((x_1, x_2 \ldots x_{12})\) and the dependent variable level of living \((y)\), a multiple regression was computed to determine the value of the
independent variables in predicting level of living. The regression equation was \( y = a + b_1 x_1 + b_2 x_2 + \ldots + b_{12} x_{12} \). It was assumed (1) that the effects of the variables are additive; (2) the error (unexplained residual) is normally and independently distributed; and (3) the variance of the \( x \)'s is equal for all \( y \)'s.

The various beta coefficients in the multiple regression equation were determined by the method of least squares. The equation is as follows:

\[
y = 57.585 + .0652x_1 - .4350x_2 - .1672x_3 + .2540x_4 + .4480x_5 + .6312x_6 + .1276x_7 + .1573x_8 + .0194x_9 + .0681x_{10} + .0032x_{11} - .0382x_{12}
\]

where

- \( x_1 \) = size of farm
- \( x_2 \) = percent tenancy
- \( x_3 \) = number of farm persons per 100 acres
- \( x_4 \) = mechanisation index
- \( x_5 \) = corn yield
- \( x_6 \) = crop productivity
- \( x_7 \) = percent 1940 population is of the 1900 population
- \( x_8 \) = percent rural farm population
- \( x_9 \) = township participation rating score
- \( x_{10} \) = percent foreign born or of mixed parentage
- \( x_{11} \) = value of implements and machinery
- \( x_{12} \) = value of land and buildings
- \( y \) = farm family level of living.
Instability at the 1 percent probability level:

<table>
<thead>
<tr>
<th>Value</th>
<th>t-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.8993</td>
<td>6.041</td>
</tr>
<tr>
<td>9.5827</td>
<td>6.965</td>
</tr>
<tr>
<td>9.6769</td>
<td>6.725</td>
</tr>
<tr>
<td>5.9242</td>
<td>5.690</td>
</tr>
<tr>
<td>4.9524</td>
<td>4.719</td>
</tr>
<tr>
<td>1.6637</td>
<td>1.749</td>
</tr>
<tr>
<td>1.2501</td>
<td>1.250</td>
</tr>
<tr>
<td>0.6923</td>
<td>0.692</td>
</tr>
</tbody>
</table>

Independent variables and their corresponding $r^2$ values were:

The standard partial regression coefficients ($\hat{r}$) for the

constant.

Since variable $y$ is the only variable in which the other $x$ variables were held

y.
\[ b'_{10} = 0.034 \quad t_{10} = 2.1062^* \\
 b'_{11} = 0.043 \quad t_{11} = 2.3462^* \\
 b'_{12} = -0.044 \quad t_{12} = 1.5855 \]

The (t) values followed by a double asterisk (**) indicate the standard partial regression coefficients that were significant at the one percent probability level. Those followed by a single asterisk (*) were significant at the five percent probability level.

The (t) values were computed by dividing the standard partial regression coefficients (b') by their standard errors. Nine of the 12 variables showed a statistically significant or a highly significant association with level of living. The fact that the associations were significant from a statistical point of view may have little practical significance, especially when the magnitude of association was small. Actually, statistical significance reflects the stability of the association in question, answering only the first question of reliability, not the crucial question of degree of control. In general, the above standard partial regression coefficients indicated the relative importance of the variables in predicting level of living. Here the crop productivity index showed the highest rate of change in level of living for each unit change in itself. This was followed by percent 1940 population is of the 1900 population and by percent tenancy.

Consideration of associations and the explanations of the various levels of living, raised the question of interrelationships among the variables. These were computed and are presented in Table 4.
variables used in the multiple regression equation

<table>
<thead>
<tr>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop productivity index</td>
<td>Percent 1940</td>
<td>Percent Township population</td>
<td>rural farm participation is of the population</td>
<td>rating</td>
<td>mixed inery per per acre</td>
<td>Value of foreign implements</td>
</tr>
<tr>
<td>1900 population</td>
<td>score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.10</td>
<td>-.13</td>
<td>.15</td>
<td>-.08</td>
<td>.02</td>
<td>-.24</td>
<td>-.10</td>
</tr>
<tr>
<td>.59</td>
<td>.11</td>
<td>.03</td>
<td>.09</td>
<td>.27</td>
<td>.26</td>
<td>.50</td>
</tr>
<tr>
<td>.08</td>
<td>.29</td>
<td>-.13</td>
<td>.04</td>
<td>.21</td>
<td>.28</td>
<td>.27</td>
</tr>
<tr>
<td>.73</td>
<td>.21</td>
<td>-.80</td>
<td>.26</td>
<td>.50</td>
<td>.63</td>
<td>.79</td>
</tr>
<tr>
<td>.54</td>
<td>.06</td>
<td>-.14</td>
<td>.24</td>
<td>.35</td>
<td>.49</td>
<td>.63</td>
</tr>
<tr>
<td>1.00</td>
<td>.29</td>
<td>.12</td>
<td>.16</td>
<td>.42</td>
<td>.50</td>
<td>.79</td>
</tr>
<tr>
<td>.29</td>
<td>1.00</td>
<td>-.22</td>
<td>.11</td>
<td>.19</td>
<td>.26</td>
<td>.27</td>
</tr>
<tr>
<td>.12</td>
<td>-.22</td>
<td>1.00</td>
<td>-.12</td>
<td>.01</td>
<td>-.09</td>
<td>-.09</td>
</tr>
<tr>
<td>.16</td>
<td>.11</td>
<td>-.12</td>
<td>1.00</td>
<td>.00</td>
<td>.22</td>
<td>.24</td>
</tr>
<tr>
<td>.42</td>
<td>.19</td>
<td>.01</td>
<td>.00</td>
<td>1.00</td>
<td>.32</td>
<td>.41</td>
</tr>
<tr>
<td>.50</td>
<td>.26</td>
<td>-.09</td>
<td>.22</td>
<td>.32</td>
<td>1.00</td>
<td>.61</td>
</tr>
<tr>
<td>.79</td>
<td>.27</td>
<td>-.09</td>
<td>.24</td>
<td>.41</td>
<td>.61</td>
<td>1.00</td>
</tr>
</tbody>
</table>

highly significant, d.f. = 1565.
The coefficients indicate the intercorrelations between the independent variables. If two independent variables are correlated with each other perfectly (r=1), then the use of either one or the other is justified in the analysis. Nothing will be gained from using both variables in the major regression equation. In this analysis none of the paired combinations showed a correlation of more than ± .50.

Of the 66 possible pairs of independent variables, only five showed non-significant correlation coefficients, while 14 pairs showed correlation coefficients of ± .50 or more. Size of farm, percent tenancy, and farm persons per 100 acres were found to be correlated significantly with all the other variables except one each. Percent rural farm population and township participation rating score correlated significantly with all the other variables except two each, while percent foreign born and of mixed parentage correlated significantly with all the other variables except three. Each of the variables showed a significant or highly significant correlation coefficient with all, or nearly all, of the other variables. Mechanization index, crop productivity, value of implements and machinery and value of land and buildings were correlated .50 or more with from four to six other variables.

While the above intercorrelation analysis pointed up the various significant correlation combinations among the independent variables used in this study, the significance of the (t) value computed for each
of the beta coefficients in the multiple regression equation determined the importance of each of the variables for predicting level of living.

On the basis of lack of significance as determined by the (t) values and other pertinent information, the following five variables were dropped from further consideration in this study: (1) number of persons per 100 acres ($x_1$); (2) mechanization index ($x_4$); (3) corn yield ($x_5$); (4) township participation rating score ($x_9$); and (5) percent foreign born and of mixed parentage ($x_{10}$). The first is inversely related to farm size, but, showing no significance, was dropped. The second, likewise showed no significance, and since it is reflected by the more inclusive variable value of implements and machinery, it was eliminated. Corn yield, while showing a highly significant value, may be considered a part of the more inclusive variable of crop productivity, hence was dropped. The township participation rating score, while showing a highly significant value, was considered too limited in its inclusiveness of organizational participation among farm families and the data of not recent enough origin for retention in this analysis. The percentage foreign born and of mixed parentage, while showing a significant value, was dropped from further analysis because of its date, (1930). It is assumed that more recent data would have been useful for analysis by areas. Its consideration up to this point helped to confirm the hypothesized relationship between level of living and ethnic configuration in Iowa. Logically, value of land and buildings, which
showed no statistical significance, should have been dropped from
further consideration. The decision to retain it was premised on
the practical consideration of widespread interest in this variable
and its hypothesized relationship to level of living in areas smaller
than that of a state, as will be considered particularly in Chapters
VI and VII.

This drop-out procedure left seven independent variables for
further use in this study. ¹

Having dropped five of the twelve variables from the regression
equation, the equation was solved for the new beta coefficients. It
became:

\[ y = 82.7877 + .1318x_1 - .2499x_2 + .3741x_6 - .0034x_7 - .0191x_8 + \\
.0095x_{11} + .2465x_{12} \]

where

- \( x_1 \) = size of farm
- \( x_2 \) = percent of tenancy
- \( x_6 \) = crop productivity
- \( x_7 \) = percent 1940 population is of the 1900 population
- \( x_8 \) = percent rural farm population
- \( x_{11} \) = value of implements and machinery

¹ For reference to the precedent of dropping more than one non-
significant variable at a time without a recomputation of the regres-
sion equation see Johnson, Palmer C. Statistical methods in research.
additional significant variables and retention of a non-significant
variable was a decision of the author made after consultation and much
discussion with researchers qualified to hypothesize the relationship
of the variables retained with level of living on a small area basis.
\[ x_{12} = \text{value of land and buildings} \]
\[ y = \text{farm family level of living}. \]

The multiple correlation coefficient \((R)\) was \(0.8148\). This was only \(0.0349\) below that of \(0.8497\) computed for the 12 variables. The corresponding coefficient of determination \((R^2)\) was \(0.6639\). In other words about 66 percent of the variation in level of living was associated with the independent variables. Statistically, the reduction in the multiple correlation coefficient through dropping five of the variables was found to be highly significant. Practically, however the usefulness of data which is old or which shows a fairly high correlation with other more inclusive variables is questioned. Their inclusion up to this point was principally for exploratory purposes.

As for the 12 variables, an assessment of the contribution of each of the seven variables through the standard partial regression analysis was done.

The standard partial regression coefficients \((b')\) for the seven variables and their corresponding \((t)\) values were as follows:

\[
\begin{align*}
b'_1 &= 0.153 & t_1 &= 9.07^{**} \\
b'_2 &= -0.101 & t_2 &= 5.18^{**} \\
b'_6 &= 0.471 & t_6 &= 14.36^{**} \\
b'_7 &= -0.004 & t_7 &= 0.26 \\
b'_8 &= -0.018 & t_8 &= 1.09 \\
b'_{11} &= 0.146 & t_{11} &= 7.59^{**} \\
b'_{12} &= 0.328 & t_{12} &= 10.52^{**}
\end{align*}
\]

\(^{1}\) Significant at the 1 percent probability level.
need. Table $8$ is devoted to what

examination for the seven variables, except for the power variable.

In Table $7$, the simple correlation coefficient was estimated.

The value of importance and magnitude was then multiplied when correlated with level of intake after showing the highest correlation coefficient and value of intake and magnitude. The value of intake importance and magnitude were estimated in a negative manner. In the simple correlation coefficient of 1960 population and percent term farm population association with level of intake, percent term association of intake and magnitude and importance for the state as a whole, farm size and value of crop productivity and magnitude for the state as a whole, were by mere as meaning that the importance of the variable increased on the hypothesis that the importance of the variable increased. These two variables for further analysis. The degree was needed to be at a magnitude. The two non-relevant terms were the two population

were the two of farm, percent tenancy and value of importance and the three relevant variables showed an association. This association showed a need of interaction with it and together. The magnitude level with that change in level. Value of land and magnitude, while the productivity showed the highest rate of change in level of intake. These crops were significantly at the one percent probability level, as shown by (x).
Table 5. Intercorrelations among the 7 variables used in the multiple regression equation

<table>
<thead>
<tr>
<th></th>
<th>Size of farm, acres</th>
<th>Percent of farm land tenant operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population is of the 1900 population</th>
<th>Percent rural farm population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of farm, acres</td>
<td>1.00</td>
<td>.24</td>
<td>.10</td>
<td>-.13</td>
<td>.15</td>
<td>-.24</td>
<td>-.10</td>
</tr>
<tr>
<td>Percent farm land tenant operated</td>
<td>.24</td>
<td>1.00</td>
<td>.59</td>
<td>.11</td>
<td>.03</td>
<td>.26</td>
<td>.50</td>
</tr>
<tr>
<td>Crop productivity index</td>
<td>.10</td>
<td>.59</td>
<td>1.00</td>
<td>.29</td>
<td>.12</td>
<td>.50</td>
<td>.79</td>
</tr>
<tr>
<td>Percent 1940 population is of the 1900 population</td>
<td>-.13</td>
<td>.11</td>
<td>.29</td>
<td>1.00</td>
<td>-.22</td>
<td>.26</td>
<td>.27</td>
</tr>
<tr>
<td>Percent rural farm population</td>
<td>.15</td>
<td>.03</td>
<td>.12</td>
<td>-.22</td>
<td>1.00</td>
<td>-.09</td>
<td>-.09</td>
</tr>
<tr>
<td>Value of implements and machinery per 100 acres</td>
<td>-.24</td>
<td>.26</td>
<td>.50</td>
<td>.26</td>
<td>-.09</td>
<td>1.00</td>
<td>.61</td>
</tr>
<tr>
<td>Value of land and buildings per acre</td>
<td>-.10</td>
<td>.50</td>
<td>.79</td>
<td>.27</td>
<td>-.09</td>
<td>.61</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Significant values are 0.06 and 0.07. Those of 0.05 and above are highly significant, d.f. = 1585.
The coefficients indicate the intercorrelation between the independent variables. Of the 21 possible pairs of independent variables, only one showed a non-significant correlation coefficient, and that was percent tenancy with percent rural farm population. Percent tenancy, crop productivity, value of implements and machinery, and value of land and buildings were correlated .50 or more with from two to three other variables. The first three of the four variables were found to correlate .50 or more with value of land and buildings. Percent tenancy, value of implements and machinery and value of land and buildings were found to correlate .50 or more with crop productivity.

F. Summary

While in a generalized sense, Iowa is considered a segment of a larger universe of similarities, wide variations in farm family level of living were found within its borders. Township indexes ranged from 60 to 223.

The use of township farm family level of living indexes made possible identification of: (1) variations within counties, and (2) similar levels of living that cut across county lines.

The lowest one-fifth of the township indexes were located in the south, west and northeast parts of the state, the highest one-fifth extended from southeast to northwest Iowa. The middle one-fifth of the townships represented by the index level of 140-159
non-homogeneous areas.

For one in the other two analyses were non-significant and were revised combinations to be significant at the 0.01 level of integrity. Standard partial regression analysis showed a range of the seven

accounted for most of the variation.

An increase in the correlation coefficient, or group population, 0.50 population, 0.34 population, 0.25 population, 0.17 population, and 0.07 population was observed in the ratio of the treatment to the control group. The correlation coefficient of 0.75, which accounted for 55 percent of the correlation coefficient, showed a moderate to high relationship and a strong correlation between a selected group of variables and

which is at least a ratio.

Adequate and a large in which random selection was carried

percent. The numerical increases in index points range from 12 to 39

between 1940 and 1949, the farm family level of living index

seven counties had 16 percent increase in income. Percent of the counties. Only

Large index increases were found in four of the counties. Only

range of index increases from the lowest to the highest level of

appears to have the least propensity for contiguity.
The presentation generally has demonstrated the usefulness of the township indexes for showing variations in levels of living within the state and within counties and for identification of concentrations of various levels of living that cut across county lines. The sensitivity of the township indexes to changes in physical, economic and social factors affecting family living makes the use of a unit as small as a township highly desirable for identification and analysis of areal variation in levels of living.
V. FARM FAMILY LEVEL OF LIVING BY
TYPE OF FARMING AREAS

A. Introduction

Proceeding from an overall analysis of farm family levels of living in Iowa, the next step was to determine how well the five type of farming areas (Western Meat, North Central Grain, Northeast Dairy, East Central Meat and Southern Pasture) differentiated farm family levels of living and whether or not such areas may be considered as useful bases for more intensive analyses of levels of living.

B. Type of Farming Area Concept

Type of farming areas constitute meaningful areal universes, whose delineation is the end product of years of production-economic study. They are especially significant as rural universes. It is assumed that within each the ways of making a living are roughly uniform and that the production of the same product, or combination of products, peculiar to each area results in a certain amount of common activity and broadly similar interests, values and attitudes.

Differences among type of farming areas have arisen in response to a combination of physical, economic and historical factors. The
way the farm work is done in the various areas gives each a distinguishing characteristic. Farm tenants are much more prevalent in some than in others. Certain areas are more highly mechanized than others, and require appropriate machinery for carrying on the prevailing enterprises. Work cycles differ, for example, from the cash grain farm to the dairy farm, the latter requiring regular daily work throughout the year. Types of special interest groups differ from area to area, and are associated closely with the prevailing agricultural enterprises. This points up only some of the whole complex of production-economic-cultural activities which broadly serve to characterize type of farm areas. The variations would imply significant differences in levels of living from area to area.

C. Characteristics of Type of Farming Areas

The Western Meat area extends north and south along the western border of the state, Figure 7. Populated somewhat later than eastern and southern Iowa, small farms never became a very great problem. For the past 50 years the number of people on farms has been decreasing. The area specializes in hogs and cattle feeding though still having a diversified farming system. Considerable cash corn is sold, especially from river bottom farms.

1The description of the individual areas is based largely on the publication: Iowa Agricultural Extension Service, Program Planning Committee, op. cit.
Fig. 7. Type of farming areas
The population density is still about as large as in 1900, and the greatest
and highest. In spite of dozing over the past 50 years, farm
hearty of foreign immigrant, especially German. Scandinavian, Dutch
that part of the state. The area was settled relatively early. During the
pre-post area more than adds the more rolling counties of
farm is common throughout the area.
area, with cattle and sheep being relatively important. Part-time
although considered more than is needed. There is the need for more of
the area have the largest proportion of land in permanent pastures.
number of people on farms have decreased forty years since 1890.
area and a large number of operators are other farmers. The
since 1890, when the dispute population tendency to migrate and an
the peak population was reached well before 1900 and has been decreasing.
state. Most of the renters are descendants of old American stock.
the Southern Prairie area was one of the earliest settled in the
farms are operated by tenants in other areas.
income than cattle, and both cattle and poultry are important. More
increases than cattle, however, livestock, especially hogs, bring in a larger
the area produces much corn and oats, and more recent adaptations, for
the farm population never became large relative to the resources.
the Scandinavian, German, Dutch, and Irish settled in this area.
considerable investment in land preparation. Many important industries
be realized until much of the land had been drained, but
be settled. The level of immigration prior to the period could not
be settled.

The North Central Prairie area was about the largest in Iowa to
than that of other areas in the state. The area more properly might
be called hog-dairy, since hogs are its largest single source of
income. However, dairying is more important here than elsewhere in
the state. Poultry is an important enterprise.

The Eastern Livestock area was populated early in the history
of Iowa, much of it by 1860. Germans comprised about half of the
total foreign born immigrants, though a number of communities were
made up of Scandinavians, Irish, English and Bohemians. In making
the adjustment to resources, population shifts have resulted in a
decline of about a third in the farm population in the last 50
years. The area is the most intensive in hogs, although cattle
feeding and dairying are both important. Grain acreage is fairly
large and yields are high, but nearly all grain produced is fed
locally. A larger proportion of farmers than in any other area report
off-farm work.

Many similarities and dissimilarities exist among the areas. How
these may affect farm family levels of living, and whether or not the
areas are important considerations in level of living analyses, will
be treated next.

D. Analysis of Data by Type of Farming Areas

Type of farming area delineations follow county lines, therefore,
county level of living indexes, rather than township level of living
indexes, are the data used. The five areas range in size from 18 to
21 counties each. The mean level of living in 1945 ranged from 133 to 179. Five years earlier, the range was from 111 to 149. During the five year period an increase of eight index points occurred in the range from low to high; Inasmuch as county data represent larger aggregates than township data, differences and variations between and among county data usually will not be as great as that of townships.

A measure of average variation in levels of living is the standard deviation. Over the five year period the standard deviation increased from 17.1 to 20.6. Four of the five areas had higher standard deviations in 1945 than in 1940. Only the East Central Meat showed a decline.

North Central Cash Grain with a standard deviation of 8.6 indicated the greatest homogeneity of county level of living indexes; while Western Meat with a standard deviation of 16.3, or nearly double that of the first area, the greatest heterogeneity. Both areas maintained their homogeneity and heterogeneity, respectively, over the five year period. Southern Pasture showed the greatest numerical, as well as proportional, increases in standard deviation between 1940 and 1945. This would seem to confirm that during the five year period heterogeneity in levels of living of farm families in this area increased.
Considering only standard deviation for 1945, homogeneity to heterogeneity by areas proceeded from North Central Grain, to East Central Meat, to Northeast Dairy, to Southern Pasture and to Western Meat.

Table 6. Means and standard deviations of farm family level of living indexes for counties by type of farming areas, Iowa, 1940 and 1945

<table>
<thead>
<tr>
<th>Type of farming areas</th>
<th>Western Meat</th>
<th>North Central Grain</th>
<th>North-east Central Meat</th>
<th>East Central Meat</th>
<th>Southern Pasture</th>
<th>All areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. counties</td>
<td>21</td>
<td>20</td>
<td>18</td>
<td>20</td>
<td>20</td>
<td>99</td>
</tr>
<tr>
<td>Mean (1945)</td>
<td>168.9</td>
<td>178.6</td>
<td>158.9</td>
<td>172.0</td>
<td>133.0</td>
<td>162.4</td>
</tr>
<tr>
<td>Mean (1940)</td>
<td>135.9</td>
<td>145.8</td>
<td>126.7</td>
<td>143.7</td>
<td>110.7</td>
<td>133.1</td>
</tr>
<tr>
<td>Standard deviation (1945)</td>
<td>16.3</td>
<td>8.6</td>
<td>12.8</td>
<td>11.6</td>
<td>13.5</td>
<td>20.6</td>
</tr>
<tr>
<td>Standard deviation (1940)</td>
<td>15.5</td>
<td>8.0</td>
<td>10.7</td>
<td>11.9</td>
<td>9.3</td>
<td>17.1</td>
</tr>
</tbody>
</table>

To more adequately determine the usefulness or non-usefulness of the type of farming areas as bases for the study of level of living, the total of the five areas and all possible two-area combinations were subjected to analysis of variance, Table 7. It was hypothesized that significant differences in level of living were to be found among and between the areas. Differences in means suggested that possibility. However, means do not give any indication of the variance of individual county indexes around the means within the type of farming areas.
areas or with the variance of the area means around the general mean of the ungrouped data.

For the total a highly significant difference was indicated. Of the ten possible two-area combinations, five showed a highly significant difference, three showed a significant difference and two showed no difference. The hypothesis of significant difference was confirmed for eight of the ten two-area combinations. That a highly significant difference, or at least a significant difference, was not found for all ten two-area combinations suggests the inadvisability of using type of farming areas as bases for further analysis of levels of living. More important was the fact that four of the five highly significant

Table 7. The "F" results of the analysis of variance of level of living indexes by counties for all two-area combinations of type of farming areas, and for total

<table>
<thead>
<tr>
<th>Type of farming areas</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>North</td>
</tr>
<tr>
<td>Western Meats</td>
<td>4.6*</td>
</tr>
<tr>
<td>North Central Grain</td>
<td>34.3**</td>
</tr>
<tr>
<td>Northeast Dairy</td>
<td>14.6**</td>
</tr>
<tr>
<td>East Central Meat</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13.6**</td>
</tr>
</tbody>
</table>

*Significant at the 5 percent probability level.
**Significant at the 1 percent probability level.
differences were between Southern Pasture and the other four areas. Northeast Dairy and East Central Meat represented the fifth two-area combination showing a highly significant difference in levels of living.

E. Summary

From the above results, it was not believed that much additional information over that for the state as a whole could be gained in pursuing more intensive analysis of levels of living on the type of farming area basis. While a number of dissimilarities in agricultural production activities and in some of the population characteristics exist, those differences were not strongly indicated for levels of living except in comparisons of Southern Pasture with the other four areas.

Rejection of type of farming areas as useful for our purposes does not mean that such areas are not useful for analysis of other types of data. Two questions may be raised however. Do each of the areas have a central core around which the much larger area is built? Are those cores sufficiently unique to adequately differentiate levels of living? Considerable additional research will be needed to provide the answers.
VI. FARM FAMILY LEVEL OF LIVING BY PRINCIPAL
SOIL ASSOCIATION AREAS

A. Introduction

The analyses in Chapters IV and V were concerned principally with the overall view of level of living of farm families in Iowa. Type of farming areas provided only generalized differentiations in levels of living. The analysis in this chapter deals with determining how well adapted the principal soil association areas of the state are for differentiating levels of living. Such areas are the product of many years of mapping and classification of soil types by soil scientists.

The magnitude of the crop productivity and level of living association was indicated in Chapter IV. Inasmuch as crop productivity is influenced partially by the properties of the soil, it was hypothesized that soil areas differentiate levels of living and related factors with considerable reliability. With this brief background, the analysis of the data is presented and discussed.

B. Soil Association Area Concept

A soil association area represents,

A repeating pattern of soil types rather than soil uniformity . . . . Each soil association has an arrangement of soil types and other features, principally topography, which gives it a characteristic
landscape . . . therefore, is simply a group of soil types which are most commonly found in a given area.\(^1\)

In a further elaboration on their concept of soil association area, Ricken and Smith have said,

The soils of each soil association area is the resultant of the various factors that have influenced the formation of the various soil types. These factors are as follows: (1) Parent or geological material, (2) natural vegetation and other biological factors, (3) topography or lay-of-the-land, (4) climate, (5) length of time that the soils have weathered.

All of these factors need to be considered in interpreting and explaining the different properties of the various soil types.\(^2\)

In order to further clarify the soil association area concept, it is necessary to distinguish between the two major types of land classification--physical and use.

Physical classification groups soils according to their natural qualities, while use classifications include, in addition to these physical factors, all economic forces which condition the use man makes of land. When land is classified on the basis of physical or inherent characteristics alone, certain natural qualities are looked for such as topography, soil characteristics, vegetative cover, rainfall, chemical composition, position, and similar physical factors.\(^3\)

Renne listed three principal types of land classification within the use classification: "(1) present use, (2) use capabilities, and (3) recommended use."\(^4\) Thus, he said that in addition

\(^{1}\)Riecken, F. F. and Smith, Guy D. op. cit., p. 2.
\(^{2}\)Ibid., p. 3.
\(^{3}\)Renne, Roland R. Land economics. N. Y., Harper and Bros., 1947, p. 40.
\(^{4}\)Ibid., p. 42.
to natural qualities of the land,

... economic considerations such as market accessibility; size and type of operating unit; size, distribution and composition of the population; location of roads, schools, power lines, stores, factories, and mines; location, size and type of properties; type of ownership; economic outlook and price prospects; transport facilities; costs of production; and related economic items must be taken into consideration in determining uses to which the land can be most efficiently put.¹

While the prevailing level of living of people on the land was implied, the implicitness was not clear in the foregoing listing of considerations. The writer is not aware of any instances where level of living has been included as one of the components on any wide scale land use classification. This is not surprising, because areal indexes of level of living are relatively new and in previously published form have been confined to units no smaller than a county. A large unit is not practicable for most land use classification purposes.

C. Principal Soil Association Areas in Iowa

The eight principal soil association areas used in this analysis are shown in Figure 3.²

¹Ibid., p. 42.

²See Riecken and Smith, op. cit., opposite p. 2. The principal soil association area boundaries in Figure 3 represent slight modification of those shown in the above publication. The modifications were concurred in by the authors and F. L. Thompson of the Iowa State College Agronomy Department and A. R. Aandahl formerly of that department. The modifications were effected insofar as possible by including highly similar soil types together in each area.
Fig. 5. Principal soil association areas
While solid lines have been used in this figure to differentiate the soil association areas one from another, the transition from one association to another in some instances is gradational, as from areas 3 to 4, from 6 to 7 and from 7 to 8. Changes between other areas are more abrupt and definitive. Iowa's major surface deposits originated primarily from deposition by ice or by wind in the geologic past. Associated with these deposits is material which has been laid down by the streams along their banks in recent times, or in the more or less distant past. Glacial deposits covered all or nearly all of the state. Several different ice sheets invaded the state at different times but not all covered the state. The action of the more recent glaciers accounts to a high degree for the large areas of relatively level land in much of Iowa. The rougher areas represent what is known as a mature topography.\(^1\)

As shown in Figure 3, in the west two-thirds of the state the soil contours or delineation lines are fairly regular. Each of the principal soil associations covers considerable area. For a listing of soil types within each area, see Table 9. In the east one-third of the state, considerable dissection is evident, much of it due to the action of rivers. If the assumption is

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correct that soil areas differentiate levels of living, then in areas of considerable dissection wide variations in levels of living may be expected.

D. Measure of Soil Productivity

Crop productivity is the usual criterion, for lack of any other more satisfactory and easily used measure, for estimating the productivity of a soil. It may be considered as a measure of the productivity of a stated soil under a given state of cultural arts. The extent to which a given state of cultural arts mirrors the potential of a soil cannot be determined without consideration of a whole complex of physical, social and economic factors affecting production. For example, the nature of the soil pattern influences the management, and thus has an indirect effect on crop yields. The interaction between soil patterns and management exists partly because the tillage operations are conditioned by the soil patterns. Climatic fluctuations affect soil productivity. Similarly, the level of production of a soil does not remain constant even when the system of management remains the same.

In an evaluation of methods involving soil productivity data, Aandahl pointed out that, "All methods involve yield measurements or estimates and these may be either relative or absolute."1 The

crop productivity index used in this study covered a five year period. Thus, annual fluctuations were minimized and the usefulness of the index as an indicator of soil productivity increased.

E. Relationship of Level of Living to Selected Social and Economic Variables

This part of the study is concerned: (1) with empirically determining how well adapted the principal soil association areas are for differentiating farm family levels of living; and (2) with testing the associational relationships between and among the variables selected for analysis with level of living in the eight soil association areas. Little or no research has been conducted on attempting to predict level of living from selected variables by soil area. Therefore, little is known about the relationships of those variables with level of living or how they differ in their relationships to each other. Preliminary to the more critical analysis, data pertaining to the size of the areas and means of the variables by areas will be examined.

The areas ranged in size from 103 to 333 townships, Table 5. Three of the eight areas 1, 2, and 4 showed relatively high and nearly identical means in level of living, 181 to 184. The first two are characterized by cash grain farming, the third by livestock raising and dairying. Mean levels of living in the other areas ranged from 174 to 170.
general determination of that or value of improvements and machinery
value of land and buildings tended to correspond to the same

operative equipment.

and waterfaring predominated showed the higher elevations in
in general, those soil associations were in which the grain
earlobe variation from area to area, range from 676° to 71.7°.
value of improvements and machinery per 100 acres owned

up on a natural farm population.

the larger number of communities already, or almost entirely,
percentages in each of the areas attended were an indication of
from area to area. The high unweighted mean of the

percentage farm population showed considerable uniformity.

only area 1 and 2 showed generalized natural farm population increases.

indicated that in any of the areas depressions were shown.

ed by the average of the percentages for the intermediate communities.

percent 1940 population is of the 1900 population, as Respect-

highest in those areas predominating in grain grain farming

range from 80 to 90 in the 1900s, in general, because

the crop predominating generally varied widely from area to area.

each grain farming tended to show higher general rates.

considerable diversification in farming. Areas of predominating

be the lowest in the soil associations on areas characterized
areas. percent tended varied from 79 to 51 percent, in general
areas. the size of farm varied by 3 to 5 acres from low to high
Table 3. Number of townships and means of farm family level of living indexes and of seven selected variables by principal soil association areas, Iowa

<table>
<thead>
<tr>
<th>Soil association areas</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>All areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of townships</td>
<td>127</td>
<td>333</td>
<td>180</td>
<td>215</td>
<td>254</td>
<td>253</td>
<td>121</td>
<td>103</td>
<td>1586</td>
</tr>
<tr>
<td>Farm family level of living index&lt;sup&gt;a&lt;/sup&gt;</td>
<td>183.6</td>
<td>180.8</td>
<td>162.8</td>
<td>181.1</td>
<td>149.1</td>
<td>133.8</td>
<td>170.4</td>
<td>147.4</td>
<td>163.5</td>
</tr>
<tr>
<td>Size of farm&lt;sup&gt;a&lt;/sup&gt;; acres</td>
<td>195.8</td>
<td>184.2</td>
<td>165.9</td>
<td>169.6</td>
<td>169.7</td>
<td>180.6</td>
<td>187.2</td>
<td>197.4</td>
<td>179.3</td>
</tr>
<tr>
<td>Percent tenancy&lt;sup&gt;a&lt;/sup&gt;</td>
<td>61.1</td>
<td>58.1</td>
<td>52.4</td>
<td>51.7</td>
<td>39.0</td>
<td>45.0</td>
<td>54.0</td>
<td>55.8</td>
<td>51.2</td>
</tr>
<tr>
<td>Crop productivity index&lt;sup&gt;a&lt;/sup&gt;</td>
<td>125.3</td>
<td>128.8</td>
<td>88.8</td>
<td>106.5</td>
<td>63.8</td>
<td>54.0</td>
<td>111.2</td>
<td>102.5</td>
<td>95.6</td>
</tr>
<tr>
<td>Percent 1940 population is of 1900 population&lt;sup&gt;a&lt;/sup&gt;</td>
<td>102.3</td>
<td>104.7</td>
<td>99.1</td>
<td>88.1</td>
<td>82.4</td>
<td>78.6</td>
<td>81.3</td>
<td>90.3</td>
<td>91.2</td>
</tr>
<tr>
<td>Percent rural farm population&lt;sup&gt;a&lt;/sup&gt;</td>
<td>74.1</td>
<td>71.6</td>
<td>71.6</td>
<td>72.1</td>
<td>70.8</td>
<td>76.1</td>
<td>77.1</td>
<td>72.6</td>
<td>73.0</td>
</tr>
<tr>
<td>Value of implements and machinery per 100 acres&lt;sup&gt;a&lt;/sup&gt;</td>
<td>$172</td>
<td>1314</td>
<td>1205</td>
<td>1272</td>
<td>930</td>
<td>676</td>
<td>1002</td>
<td>944</td>
<td>1084</td>
</tr>
<tr>
<td>Value of land and buildings per acre&lt;sup&gt;a&lt;/sup&gt;</td>
<td>$132</td>
<td>135</td>
<td>97</td>
<td>123</td>
<td>78</td>
<td>65</td>
<td>107</td>
<td>89</td>
<td>103</td>
</tr>
</tbody>
</table>

<sup>a</sup>Data presented represents the unweighted means of township means or township percentages.
The mean values shown in the table indicated the greatest proportional variability in crop productivity, value of implements and machinery and value of land and buildings. All three showed high values in certain areas and low values in others.

Figure 9 shows the principal soil association areas superimposed upon a map of farm family level of living by townships. This groups the townships into areas in which relatively homogeneous soil types prevail. A township was included in a particular soil association area on the basis of whether or not more than one-half of the township was located within it. Because of the small size of a township, it was well suited to this type of arbitrary inclusion or exclusion.

It can be assumed from the foregoing, and particularly from inspection of Figure 9, that in terms of levels of living most of the soil association areas differed one from another. While wide ranges in levels of living were found in each of the areas, the clustering of most of the indexes within rather narrow limits was evident. The standard deviations ranged from 15.4 to 24.5 for the eight areas. The standard deviation for the state was 27.2. Area 5, which is wholly within the east central and southeast part of the state, showed the greatest heterogeneity in township level of living indexes. Area 2, characterized by a relatively high soil fertility and level land, showed considerable homogeneity. In terms of extremes in range from low to high index, area 1 showed
Fig. 9. Farm family level of living by townships and principal soil association areas
the least range 143-225, while area 5 showed the greatest range, 88-215.

Considering only standard deviation, homogeneity to heterogeneity in level of living proceeded area by area in the following manner, area 2, 7, 4, 6, 3, 1, 8 and 5. In general, this progression was from level to increasingly broken and hilly terrain, or from the least to the most mature areas of the state.

To further determine the variability of level of living of farm operator families between and among the various soil areas, the total and all possible two-area combinations were subjected to analysis of variance. Differences in most of the means suggested the hypothesis that significant differences in levels of living were to be found among and between the areas. The F's for the 28 two-area combinations are given in Table 10.

A highly significant difference for total and for 24 of the 28 possible two-area combinations was found. No significant difference was found between the following two-area combinations: 1 and 2, 2 and 4, 1 and 4, and 5 and 8. Areas 1, 2 and 4 are those located in the least mature, while 5 and 8 are located in the more mature areas of the state. In general, the hypothesis that soil association areas do differentiate between farm family levels of living was supported.

The discussion thus far has dealt with areal variations in levels of living. The next step was to analyze by areas the associational relationships of level of living to the selected group of seven variables. First, simple correlations between each of the independent
Table 9. Soil types, number of townships, means, ranges and standard deviations of farm family level of living indexes by principal soil association areas, Iowa, 1945

<table>
<thead>
<tr>
<th>Area</th>
<th>Soil types</th>
<th>Number of townships</th>
<th>Mean of level of living indexes</th>
<th>Range in level of living indexes</th>
<th>Standard deviation of level of living indexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Galva, Marcus, Moody, Primghar, Sac</td>
<td>127</td>
<td>183.6</td>
<td>143-225</td>
<td>22.1</td>
</tr>
<tr>
<td>2</td>
<td>Clarion, Storden, Webster</td>
<td>333</td>
<td>180.8</td>
<td>123-228</td>
<td>15.4</td>
</tr>
<tr>
<td>3</td>
<td>Carrington, Clyde</td>
<td>180</td>
<td>162.8</td>
<td>94-215</td>
<td>21.1</td>
</tr>
<tr>
<td>4</td>
<td>Downs, Mahaska, Muscatine, Tainter, Tama</td>
<td>215</td>
<td>181.1</td>
<td>103-222</td>
<td>20.6</td>
</tr>
<tr>
<td>5</td>
<td>Bottom Soils, Dubuque, Fayette, Lindley, Stony Lands</td>
<td>254</td>
<td>149.1</td>
<td>88-215</td>
<td>24.5</td>
</tr>
<tr>
<td>6</td>
<td>Carrington, Clyde, Mina, Grundy, Haig, Lindley, Seymour, Sharpsburg, Shelby, Weller, Winterset</td>
<td>253</td>
<td>133.8</td>
<td>60-181</td>
<td>20.7</td>
</tr>
<tr>
<td>7</td>
<td>Marshall</td>
<td>121</td>
<td>170.4</td>
<td>128-214</td>
<td>17.9</td>
</tr>
<tr>
<td>8</td>
<td>Bottom Soils, Hamburg, Ida, Monona</td>
<td>103</td>
<td>147.4</td>
<td>97-198</td>
<td>22.6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1,586</td>
<td>163.5</td>
<td>60-228</td>
<td>27.2</td>
</tr>
</tbody>
</table>
Table 10. The "F" results of the analysis of variance of farm family level of living indexes for townships, for all two-area combinations of soil association areas, and for total, Iowa

<table>
<thead>
<tr>
<th>Soil association areas</th>
<th>Soil association areas</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>2.2</td>
<td>76.1**</td>
<td>0.9</td>
<td>193.1**</td>
<td>509.7**</td>
<td>30.6**</td>
<td>175.0**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>120.9**</td>
<td>0.1</td>
<td>370.0**</td>
<td>979.6**</td>
<td>36.2**</td>
<td>291.2**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>74.9**</td>
<td>38.9**</td>
<td>202.3**</td>
<td>9.0**</td>
<td>34.5**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>233.3**</td>
<td>606.7**</td>
<td>22.9**</td>
<td>176.5**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td></td>
<td>54.3**</td>
<td>74.6**</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td></td>
<td>276.0**</td>
<td>28.0**</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td></td>
<td></td>
<td>73.2**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>295.8**</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the 5 percent probability level
**Significant at the 1 percent probability level
variables and level of living were computed, Table 11. Crop productivity showed a high degree of association with level of living in six of the eight areas. In areas 7 and 8, value of land and buildings showed the higher correlation coefficients. The degrees of association indicated for the individual areas varied widely from those for the state. Correlations for level of living and size of farm ranged from -.02 to .30; for percent tenancy from -.08 to .49; for crop productivity from .48 to .75; for percent 1940 population is of the 1900 population from -1.9 to .33; for percent rural farm population from -.25 to .07; for value of implements and machinery from .17 to .55; and, for value of land and buildings from .35 to .62.

Only in areas 5 and 8 did as many as three variables show a correlation coefficient equal to or above .50 with level of living: crop productivity, value of implements and machinery and value of land and buildings.

Levels of significance of the correlation coefficients equal to or beyond the 1 percent level of probability were indicated in all areas for crop productivity, value of land and buildings and value of implements and machinery. Percent rural farm population showed a significant correlation only in area 5. In areas 2 and 4, six of the seven variables showed a significant or highly significant correlation with level of living, while in areas 5 and 8 five of the variables did so. From the correlation coefficient
Table 11. Simple correlations of the selected variables with farm family
level of living indexes for townships, by principal soil association
areas, Iowa

<table>
<thead>
<tr>
<th>Soil association areas</th>
<th>Size of farm, acres</th>
<th>Percent of farm land tenant operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population is rural farm population</th>
<th>Percent rural farm population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.01</td>
<td>.02</td>
<td>.64**</td>
<td>-.14</td>
<td>-.08</td>
<td>.38**</td>
<td>.35**</td>
</tr>
<tr>
<td>2</td>
<td>.21**</td>
<td>.13*</td>
<td>.59**</td>
<td>-.19**</td>
<td>.07</td>
<td>.37**</td>
<td>.41**</td>
</tr>
<tr>
<td>3</td>
<td>.20**</td>
<td>-.01</td>
<td>.69**</td>
<td>.13</td>
<td>.01</td>
<td>.33**</td>
<td>.61**</td>
</tr>
<tr>
<td>4</td>
<td>.30**</td>
<td>.49**</td>
<td>.75**</td>
<td>.13</td>
<td>.01</td>
<td>.43**</td>
<td>.52**</td>
</tr>
<tr>
<td>5</td>
<td>.04</td>
<td>.25**</td>
<td>.71**</td>
<td>.33**</td>
<td>-.10</td>
<td>.55**</td>
<td>.62**</td>
</tr>
<tr>
<td>6</td>
<td>-.02</td>
<td>.32**</td>
<td>.66**</td>
<td>.09</td>
<td>-.02</td>
<td>.17**</td>
<td>.61**</td>
</tr>
<tr>
<td>7</td>
<td>.20**</td>
<td>.16</td>
<td>.48**</td>
<td>.16</td>
<td>-.11</td>
<td>.36**</td>
<td>.50**</td>
</tr>
<tr>
<td>8</td>
<td>.14</td>
<td>-.08</td>
<td>.51**</td>
<td>.29**</td>
<td>-.25*</td>
<td>.50**</td>
<td>.55**</td>
</tr>
<tr>
<td>All areas</td>
<td>.11**</td>
<td>.44**</td>
<td>.78**</td>
<td>.20**</td>
<td>-.05</td>
<td>.53**</td>
<td>.75**</td>
</tr>
</tbody>
</table>

*Significant at the 5 percent probability level.
**Significant at the 1 percent probability level.
(r = .53) of level of living and percent of land tenant operated
for the state as a whole, it was inferred that there is a propensity
to higher tenancy in the higher land value and more productive
areas of the state. It should be noted that by soil areas the higher
correlations occurred in areas 4 and 6, where ownership ranks
relatively high, thus modifying the overall inference.

Level of living and crop productivity were most highly associa-
ted in area 4, which is characterized by livestock farming. Contrary
to what might be expected the correlation coefficients were lower
in areas in which cash grain farming predominates.

In areas 5 and 6 a small amount of positive association between
level of living and percent 1940 population is of the 1900 popula-
tion was indicated. In areas 1 and 2 a small negative relationship
was shown.

The value of implements and machinery, while showing a correla-
tion of .53 with level of living for the state as a whole, showed
a coefficient that varied considerably from area to area. The
correlation coefficient was smallest in area 6, where implements and
machinery carried the lowest average value per 100 acres; and highest
in area 5 where the average value per 100 acres, although higher
than for area 6, still was below that for the state.

Among the various soil areas, correlation coefficients for value
of land and buildings and level of living showed rather wide differ-
ences. Soil areas 1 and 2, in which cash grain farming is prevalent,
had the lowest correlation coefficients.
One of the more important conclusions of the analysis in this chapter is the lack of consistency from area to area in the associational relationship between the variables and level of living. Any generalization that correlation coefficients, as found for the state as a whole, persist on a small area basis is inconsistent with these findings. The differing relationships imply the need for much additional research to find the variables which are consistent in their relationships to level of living, or the relationships imply the need for interpreting level of living more rigidly in terms of the local situation. In either event, additional study is needed to clarify this situation.

The limitations of the simple factor-by-factor analysis are evident. The correlation coefficients do not always give an indication of the relative importance of variables, because they may have intercorrelation effects not ascertainable from the simple correlation coefficients.

For the analysis of relationships among the seven independent variables \((x_1, x_2, x_6, x_7, x_8, x_{11}, \text{ and } x_{12})\) and the dependent variable level of living \((y)\), a multiple regression was computed for each of the soil areas to determine the value of the independent variables in predicting level of living in each of the areas. The regression equation was

\[
y = a + b_1x_1 + b_2x_2 + b_6x_6 + b_7x_7 + b_8x_8 + b_{11}x_{11} + b_{12}x_{12}.
\]
The various beta coefficients in the multiple regression equation were determined by the method of least squares. The equations by principal soil association areas were as follows:

Area 1 \[ y = 30.4066 + .2808 x_1 - .2057 x_2 + .7628 x_6 - .0217 x_7 - .0965 x_8 + .01145 x_{11} + .0576 x_{12} \]

Area 2 \[ y = 101.4008 + .1430 x_1 - .3377 x_2 + .4138 x_6 - .0371 x_7 - .0520 x_8 + .0161 x_{11} + .0429 x_{12} \]

Area 3 \[ y = 56.6978 + .1656 x_1 - .3092 x_2 + .5419 x_6 + .0871 x_7 - .0751 x_8 + .0101 x_{11} + .2114 x_{12} \]

Area 4 \[ y = 49.6536 + .2480 x_1 + .2123 x_2 + .4056 x_6 + .0949 x_7 + .0047 x_8 + .0151 x_{11} + .0561 x_{12} \]

Area 5 \[ y = 45.3933 + .1726 x_1 - .0538 x_2 + .5029 x_6 + .1668 x_7 + .0920 x_8 + .0147 x_{11} + .1503 x_{12} \]

Area 6 \[ y = 55.0120 + .2037 x_1 - .0248 x_2 + .3919 x_6 - .0272 x_7 - .0566 x_8 + .0102 x_{11} + .3315 x_{12} \]

Area 7 \[ y = 61.2702 + .1545 x_1 + .0931 x_2 + .2432 x_6 + .0344 x_7 - .0510 x_8 + .0207 x_{11} + .2661 x_{12} \]

Area 8 \[ y = 30.9766 + .1678 x_1 - .4113 x_2 + .2730 x_6 + .2340 x_7 + .0156 x_8 + .0354 x_{11} + .2522 x_{12} \]

where \( x_1 \) = size of farm

\( x_2 \) = percent tenancy

\( x_6 \) = crop productivity

\( x_7 \) = percent 1940 population is of the 1900 population

\( x_8 \) = percent rural farm population
I believe I am on the verge of the effort. It is necessarily timed, however,
determined in its progress, and of the seven variables cannot be deeper.

To what extent countries variance may be a factor in the

...areas.

equal representation of products, kinds of variation are needed to do an

areas, a second operation, its taking from the other, is that

expression is not from how to how or how to which is the

these matrices, more homogeneous level of tiare areas. However, the

there is a constant value of heterogeneity of level to trbuat, as the
general, the to a expression from the more matrix areas, in which

/ In the expression of those areas, Fig. 5, 7, 9, and 9 showed that, in

trian in the totalling order of areas: 4, 5, 7, 9, and 6 and

selected for this analysis in the best job of productive level of

the size of the X's and those, introduced into the variates

variations.

level of trbuat by areas was associated with the independence

6558. In other words, from 35 to 65 percent of the variational in

product co-efficient of determination (R^2) ranged from 0.96 to

.903 to .909, all higher than expected. See Table 12. The corrs-

The multiplicative correlation co-efficient (k) by areas ranged from

\[ S = \text{sum of squares between factors} \]
\[ X = \text{value of land and production} \]
\[ Y = \text{value of improvements andียง} \]
determination, standard partial regression coefficients and their principal soil association areas

<table>
<thead>
<tr>
<th>( t_6 )</th>
<th>( b'_7 )</th>
<th>( t_7 )</th>
<th>( b'_8 )</th>
<th>( t_8 )</th>
<th>( b'_11 )</th>
<th>( t_{11} )</th>
<th>( b'_12 )</th>
<th>( t_{12} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.61**</td>
<td>-0.025</td>
<td>0.26</td>
<td>-0.143</td>
<td>1.60</td>
<td>0.202</td>
<td>2.59*</td>
<td>0.085</td>
<td>0.92</td>
</tr>
<tr>
<td>7.46**</td>
<td>-0.087</td>
<td>1.82</td>
<td>-0.087</td>
<td>1.82</td>
<td>0.262</td>
<td>5.87**</td>
<td>0.068</td>
<td>1.12</td>
</tr>
<tr>
<td>4.74**</td>
<td>0.171</td>
<td>2.59*</td>
<td>0.091</td>
<td>1.52</td>
<td>0.132</td>
<td>2.06*</td>
<td>0.190</td>
<td>2.02*</td>
</tr>
<tr>
<td>6.97**</td>
<td>0.087</td>
<td>1.86</td>
<td>0.005</td>
<td>0.11</td>
<td>0.232</td>
<td>3.85**</td>
<td>0.103</td>
<td>1.92</td>
</tr>
<tr>
<td>6.40**</td>
<td>0.189</td>
<td>3.88**</td>
<td>0.093</td>
<td>2.04*</td>
<td>0.201</td>
<td>2.88**</td>
<td>0.176</td>
<td>2.06*</td>
</tr>
<tr>
<td>4.37**</td>
<td>-0.069</td>
<td>1.23</td>
<td>-0.065</td>
<td>1.32</td>
<td>0.113</td>
<td>1.49</td>
<td>0.356</td>
<td>3.59**</td>
</tr>
<tr>
<td>2.39*</td>
<td>0.033</td>
<td>0.33</td>
<td>-0.073</td>
<td>0.74</td>
<td>0.195</td>
<td>2.20*</td>
<td>0.245</td>
<td>2.43*</td>
</tr>
<tr>
<td>2.16*</td>
<td>0.217</td>
<td>2.24*</td>
<td>0.018</td>
<td>0.19</td>
<td>0.352</td>
<td>3.49**</td>
<td>0.225</td>
<td>2.25*</td>
</tr>
<tr>
<td>14.36**</td>
<td>-0.004</td>
<td>0.26</td>
<td>-0.018</td>
<td>1.09</td>
<td>0.146</td>
<td>7.59**</td>
<td>0.328</td>
<td>10.52**</td>
</tr>
</tbody>
</table>


In the above table, for the seven partners and their corresponding values, the standard partial regression coefficients are shown.

(1) In order to assess the contribution of each of the seven partners, the above hypotheses are tested.

(2) That the dummy set of criteria may be interpreted within an area? (3) That the dummy set of stationures may be ignored?

(4) That now few people define their interaction and group sizes.
job of predicting level of living.

A comparison of the importance of the partial coefficients by areas with those for the state as a whole was made next. Size of farm (b'1), percent tenancy (b'2), crop productivity (b'6), value of implements and machinery (b'11), and value of land and buildings (b'12) were highly significant for the state as a whole. Only in areas 3 and 8 were these same five variables also found to be significant or highly significant in terms of predictive value. The variable percent 1940 population is of the 1900 population (b'γ), which was non-significant on the state basis, was found to be significant in areas 3 and 8 and highly significant in area 5. Percent rural farm population (b'8), which also was non-significant for the state, was found to be significant in area 5. Only two variables, size of farm (b'1) and crop productivity (b'6) were found to be significant or highly significant in all eight of the areas; value of implements and machinery was found to be so in seven of the eight areas.

For the state, crop productivity (b'6) and value of land and buildings (b'12) showed relatively high standard partial regression coefficients. For the soil areas, crop productivity (b'6) and size of farm (b'1) in that order, showed relatively high coefficients, while the coefficients for value of land and buildings varied considerably from area to area.

These observations indicated that while certain variables held
relatively high standard partial regression coefficients with level of living on a state basis. Such relationships did not hold up consistently on a soil area basis. Significance on a state basis did not necessarily follow on the soil area basis, and vice versa, variables non-significant on the state basis showed up as significant or highly significant in some of the soil areas.

In the simple correlation analysis, Table 11, crop productivity, value of implements and machinery and value of land and buildings showed relatively high correlations with level of living, while the remaining factors showed no consistent high correlation, or practically none at all, throughout the eight areas.

In the following tables the simple correlation coefficients are examined for all paired combinations of the seven variables for each of the principal soil association areas.

Out of a possible 21 significant and/or highly significant correlations of paired combinations of variables for each area, the range was from nine in area 8 to 16 in area 6. From six to seven clusters of interdependencies or interrelationships were found in each of the areas. Each of the clusters consisted of all of the significant correlations between any one variable and all other variables within a given area, Table 21. The clusters ranged from two to seven variables each. An inspection of Tables 13 to 20 showed that the combinations of variables and the degree of association varied considerably from area to area. In some areas the interrelationships were relatively high; in others they were
Table 13. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 1, Iowa

<table>
<thead>
<tr>
<th></th>
<th>Size of farm, acres</th>
<th>Percent of farm land operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population is of the 1900 population</th>
<th>Percent rural farm population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of farm, acres</td>
<td>1.00</td>
<td>.04</td>
<td>-.31</td>
<td>-.26</td>
<td>.18</td>
<td>-.38</td>
<td>-.53</td>
</tr>
<tr>
<td>Percent farm land</td>
<td>.04</td>
<td>1.00</td>
<td>.10</td>
<td>.06</td>
<td>.01</td>
<td>.03</td>
<td>.01</td>
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<td>tenant operated</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop productivity</td>
<td>-.31</td>
<td>.10</td>
<td>1.00</td>
<td>-.19</td>
<td>.00</td>
<td>.41</td>
<td>.51</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent 1940</td>
<td>-.26</td>
<td>.06</td>
<td>-.19</td>
<td>1.00</td>
<td>-.68</td>
<td>-.03</td>
<td>.07</td>
</tr>
<tr>
<td>population is of the</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1900 population</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent rural farm</td>
<td>.18</td>
<td>.01</td>
<td>.00</td>
<td>-.68</td>
<td>1.00</td>
<td>-.05</td>
<td>-.65</td>
</tr>
<tr>
<td>population</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of implements</td>
<td>-.38</td>
<td>.03</td>
<td>.41</td>
<td>-.03</td>
<td>-.05</td>
<td>1.00</td>
<td>.59</td>
</tr>
<tr>
<td>and machinery per</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 acres</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Value of land and</td>
<td>-.53</td>
<td>.01</td>
<td>.51</td>
<td>.07</td>
<td>-.65</td>
<td>.59</td>
<td>1.00</td>
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<td>buildings per acre</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significant values are .17 to .22. Those of .23 and above are highly significant, d.f. = 126.
Table 14. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 2, Iowa

<table>
<thead>
<tr>
<th></th>
<th>Size of farm, acres</th>
<th>Percent of farm land tenant operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population is of the 1900 population</th>
<th>Percent rural farm population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of farm, acres</td>
<td>1.00</td>
<td>.29</td>
<td>.19</td>
<td>-.12</td>
<td>.33</td>
<td>-.17</td>
<td>-.14</td>
</tr>
<tr>
<td>Percent farm land tenant operated</td>
<td>.29</td>
<td>1.00</td>
<td>.41</td>
<td>-.10</td>
<td>.05</td>
<td>.03</td>
<td>.22</td>
</tr>
<tr>
<td>Crop productivity index</td>
<td>.19</td>
<td>.41</td>
<td>1.00</td>
<td>-.27</td>
<td>.12</td>
<td>.26</td>
<td>.65</td>
</tr>
<tr>
<td>Percent 1940 population is of the 1900 population</td>
<td>-.12</td>
<td>-.10</td>
<td>-.27</td>
<td>1.00</td>
<td>-.42</td>
<td>.02</td>
<td>-.03</td>
</tr>
<tr>
<td>Percent rural farm population</td>
<td>.33</td>
<td>.05</td>
<td>.12</td>
<td>-.42</td>
<td>1.00</td>
<td>.01</td>
<td>-.09</td>
</tr>
<tr>
<td>Value of implements and machinery per 100 acres</td>
<td>-.17</td>
<td>.03</td>
<td>.26</td>
<td>.02</td>
<td>.01</td>
<td>1.00</td>
<td>.34</td>
</tr>
<tr>
<td>Value of land and buildings per acre</td>
<td>-.14</td>
<td>.22</td>
<td>.65</td>
<td>-.03</td>
<td>-.09</td>
<td>.34</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Significant values are .11 to .14. Those of .15 and above are highly significant, d.f. = 332.
Table 15. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 3, Iowa

<table>
<thead>
<tr>
<th></th>
<th>Size of farm, acres</th>
<th>Percent of farm land tenant operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population is of the 1900 population</th>
<th>Percent rural farm population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of farm, acres</td>
<td>1.00</td>
<td>.17</td>
<td>.21</td>
<td>-.34</td>
<td>.26</td>
<td>-.35</td>
<td>-.10</td>
</tr>
<tr>
<td>Percent farm land tenant operated</td>
<td>.17</td>
<td>1.00</td>
<td>.14</td>
<td>.04</td>
<td>.03</td>
<td>.02</td>
<td>.04</td>
</tr>
<tr>
<td>Crop productivity index</td>
<td>.21</td>
<td>.14</td>
<td>1.00</td>
<td>.06</td>
<td>-.03</td>
<td>.32</td>
<td>.77</td>
</tr>
<tr>
<td>Percent 1940 population is of the 1900 population</td>
<td>-.34</td>
<td>.04</td>
<td>.06</td>
<td>1.00</td>
<td>-.48</td>
<td>.61</td>
<td>.29</td>
</tr>
<tr>
<td>Percent rural farm population</td>
<td>.26</td>
<td>.03</td>
<td>-.03</td>
<td>-.48</td>
<td>1.00</td>
<td>.21</td>
<td>-.11</td>
</tr>
<tr>
<td>Value of implements and machinery per 100 acres</td>
<td>-.35</td>
<td>.02</td>
<td>.32</td>
<td>.61</td>
<td>-.21</td>
<td>1.00</td>
<td>.52</td>
</tr>
<tr>
<td>Value of land and buildings per acre</td>
<td>-.10</td>
<td>.04</td>
<td>.77</td>
<td>.29</td>
<td>-.11</td>
<td>.52</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Significant values are .14 to .17. Those of .15 and above are highly significant, d.f. = 179.
Table 16. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 4, Iowa

<table>
<thead>
<tr>
<th>Size of farm, acres</th>
<th>Percent of farm land operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population of the 1900 population</th>
<th>Percent rural farm population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of farm, acres</td>
<td>1.00</td>
<td>.25</td>
<td>.12</td>
<td>-.19</td>
<td>.17</td>
<td>-.40</td>
</tr>
<tr>
<td>Percent farm land tenant operated</td>
<td>.25</td>
<td>1.00</td>
<td>.54</td>
<td>-.02</td>
<td>.05</td>
<td>.15</td>
</tr>
<tr>
<td>Crop productivity index</td>
<td>.12</td>
<td>.54</td>
<td>1.00</td>
<td>.11</td>
<td>-.04</td>
<td>.53</td>
</tr>
<tr>
<td>Percent 1940 population of the 1900 population</td>
<td>-.19</td>
<td>-.02</td>
<td>.11</td>
<td>1.00</td>
<td>-.45</td>
<td>.19</td>
</tr>
<tr>
<td>Percent rural farm population</td>
<td>.17</td>
<td>.05</td>
<td>-.04</td>
<td>-.45</td>
<td>1.00</td>
<td>-.01</td>
</tr>
<tr>
<td>Value of implements and machinery per 100 acres</td>
<td>-.40</td>
<td>.15</td>
<td>.53</td>
<td>.19</td>
<td>-.01</td>
<td>1.00</td>
</tr>
<tr>
<td>Value of land and buildings per acre</td>
<td>-.07</td>
<td>.30</td>
<td>.61</td>
<td>.14</td>
<td>-.01</td>
<td>.51</td>
</tr>
</tbody>
</table>

Significant values are .14 to .17. Those of .18 and above are highly significant, d.f. = 214.
Table 17. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 5, Iowa

<table>
<thead>
<tr>
<th></th>
<th>Size of farm, acres</th>
<th>Percent of farm land operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population is of the 1900 population</th>
<th>Percent rural farm population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of farm, acres</td>
<td>1.00</td>
<td>.00</td>
<td>-.11</td>
<td>-.02</td>
<td>.04</td>
<td>-.47</td>
<td>-.42</td>
</tr>
<tr>
<td>Percent farm land</td>
<td>.00</td>
<td>1.00</td>
<td>.42</td>
<td>.04</td>
<td>-.08</td>
<td>.18</td>
<td>.27</td>
</tr>
<tr>
<td>tenant operated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop productivity</td>
<td>-.11</td>
<td>.42</td>
<td>1.00</td>
<td>.18</td>
<td>-.14</td>
<td>.66</td>
<td>.76</td>
</tr>
<tr>
<td>index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent 1940 population</td>
<td>-.02</td>
<td>.04</td>
<td>.18</td>
<td>1.00</td>
<td>-.46</td>
<td>.23</td>
<td>.32</td>
</tr>
<tr>
<td>is of the 1900 population</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent rural farm</td>
<td>.04</td>
<td>-.08</td>
<td>-.14</td>
<td>-.46</td>
<td>1.00</td>
<td>-.13</td>
<td>-.15</td>
</tr>
<tr>
<td>population</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of implements</td>
<td>-.47</td>
<td>.18</td>
<td>.66</td>
<td>.23</td>
<td>-.13</td>
<td>1.00</td>
<td>.80</td>
</tr>
<tr>
<td>and machinery per</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 acres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of land and</td>
<td>-.42</td>
<td>.27</td>
<td>.76</td>
<td>.32</td>
<td>-.15</td>
<td>.80</td>
<td>1.00</td>
</tr>
<tr>
<td>buildings per acre</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significant values are .13 to .16. Those of .17 and above are highly significant, d.f. = 253.
Table 18. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 6, Iowa

<table>
<thead>
<tr>
<th></th>
<th>Size of farm, acres</th>
<th>Percent of farm land operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population of the 1900 population</th>
<th>Percent rural farm population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of farm, acres</td>
<td>1.00</td>
<td>.10</td>
<td>-.28</td>
<td>-.33</td>
<td>.28</td>
<td>-.21</td>
<td>-.44</td>
</tr>
<tr>
<td>Percent farm land</td>
<td>.10</td>
<td>1.00</td>
<td>.42</td>
<td>-.01</td>
<td>.13</td>
<td>-.03</td>
<td>.33</td>
</tr>
<tr>
<td>tenant operated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop productivity</td>
<td>-.28</td>
<td>.42</td>
<td>1.00</td>
<td>.13</td>
<td>-.01</td>
<td>.21</td>
<td>.82</td>
</tr>
<tr>
<td>index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent 1940</td>
<td>-.33</td>
<td>-.01</td>
<td>.13</td>
<td>1.00</td>
<td>-.36</td>
<td>.13</td>
<td>.41</td>
</tr>
<tr>
<td>population is of the</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1900 population</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent rural farm</td>
<td>.28</td>
<td>.13</td>
<td>-.01</td>
<td>-.36</td>
<td>1.00</td>
<td>-.13</td>
<td>-.11</td>
</tr>
<tr>
<td>population</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of implements</td>
<td>-.21</td>
<td>-.03</td>
<td>.21</td>
<td>.13</td>
<td>-.13</td>
<td>1.00</td>
<td>.24</td>
</tr>
<tr>
<td>and machinery per</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 acres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of land and</td>
<td>-.44</td>
<td>.33</td>
<td>.82</td>
<td>.41</td>
<td>-.11</td>
<td>.24</td>
<td>1.00</td>
</tr>
<tr>
<td>buildings per acre</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significant values are .13 to .16. Those of .17 and above are highly significant, d.f. = 252.
Table 19. Intercorrelations among the seven variables used in the multiple regression equation, principal soil association area 7, Iowa

<table>
<thead>
<tr>
<th></th>
<th>Size of farm, acres</th>
<th>Percent of farm land tenant operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population is of the 1900 population</th>
<th>Percent rural farm implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of farm, acres</td>
<td>1.00</td>
<td>.24</td>
<td>.11</td>
<td>-.05</td>
<td>.02</td>
<td>-.23</td>
</tr>
<tr>
<td>Percent farm land tenant operated</td>
<td>.24</td>
<td>1.00</td>
<td>.01</td>
<td>-.13</td>
<td>.07</td>
<td>.03</td>
</tr>
<tr>
<td>Crop productivity index</td>
<td>.11</td>
<td>.01</td>
<td>1.00</td>
<td>.07</td>
<td>.03</td>
<td>.38</td>
</tr>
<tr>
<td>Percent 1940 population is of the 1900 population</td>
<td>-.05</td>
<td>-.13</td>
<td>.07</td>
<td>1.00</td>
<td>-.67</td>
<td>.17</td>
</tr>
<tr>
<td>Percent rural farm population</td>
<td>.02</td>
<td>.07</td>
<td>.03</td>
<td>-.67</td>
<td>1.00</td>
<td>.05</td>
</tr>
<tr>
<td>Value of implements and machinery per 100 acres</td>
<td>-.23</td>
<td>.03</td>
<td>.38</td>
<td>.17</td>
<td>.05</td>
<td>1.00</td>
</tr>
<tr>
<td>Value of land and buildings per acre</td>
<td>-.14</td>
<td>.18</td>
<td>.60</td>
<td>.18</td>
<td>-.09</td>
<td>.49</td>
</tr>
</tbody>
</table>

Significant values are .17 to .21. Those of .22 and above are highly significant. d.f. = 120.
<table>
<thead>
<tr>
<th></th>
<th>Size of farm, acres</th>
<th>Percent of farm land tenant operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population is of the 1900 population</th>
<th>Percent rural farm population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of farm, acres</td>
<td>1.00</td>
<td>.32</td>
<td>-.05</td>
<td>-.09</td>
<td>.02</td>
<td>-.25</td>
<td>-.17</td>
</tr>
<tr>
<td>Percent farm land tenant operated</td>
<td>.32</td>
<td>1.00</td>
<td>.17</td>
<td>-.36</td>
<td>.13</td>
<td>.14</td>
<td>-.09</td>
</tr>
<tr>
<td>Crop productivity index</td>
<td>-.05</td>
<td>.17</td>
<td>1.00</td>
<td>-.09</td>
<td>-.17</td>
<td>.58</td>
<td>.56</td>
</tr>
<tr>
<td>Percent 1940 population is of the 1900 population</td>
<td>-.09</td>
<td>-.36</td>
<td>-.09</td>
<td>1.00</td>
<td>-.57</td>
<td>.03</td>
<td>.27</td>
</tr>
<tr>
<td>Percent rural farm population</td>
<td>.02</td>
<td>.13</td>
<td>-.17</td>
<td>-.57</td>
<td>1.00</td>
<td>-.04</td>
<td>-.35</td>
</tr>
<tr>
<td>Value of implements and machinery per 100 acres</td>
<td>-.25</td>
<td>.14</td>
<td>.58</td>
<td>.03</td>
<td>-.04</td>
<td>1.00</td>
<td>.55</td>
</tr>
<tr>
<td>Value of land and buildings per acre</td>
<td>-.17</td>
<td>-.09</td>
<td>.56</td>
<td>.27</td>
<td>-.35</td>
<td>.55</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Significant values are .19 to .24. Those of .25 and above are highly significant, d.f. = 102.
of land and building in the area where it was purchased.

Your question about whether the percentage of the total area was the same for each of the other variables in the area was well written, and I appreciate your attention to the subject. In the context of the correlation and the level of the correlation, the effect of each other on the outcome was analyzed in terms of each other's influence on the outcome of the correlation when placed into a regression equation. It turns out that most of the variables in the study were found to have a significant effect on the outcome, and the correlation coefficients were found to be very low in the cases between any pair of variables. In Table 1 we can see that the associations are not very strong and would not be sufficient to explain the observed relationships. Further analysis will be needed to predict the level of the cause and effect relationship that in a general sense is believed to be more intense in areas where 6% of the time is spent on other activities, about 75% of the activities are based on the data or the correlation coefficients were not sufficiently accurate.
Table 21. Clusters of significant interrelationships among the seven variables used in the multiple regression equation, by principal soil association areas and total

<table>
<thead>
<tr>
<th>Area</th>
<th>Size of farm, acres</th>
<th>Percent of farm land operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population</th>
<th>Percent rural farm population</th>
<th>Value of machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
<th>Unduplicated total of paired combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3,4,5,6,7</td>
<td>1,4,6,7</td>
<td>1,3,5</td>
<td>1,4,7</td>
<td>1,3,7</td>
<td>1,3,5,6</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>2,3,4,5,6,7</td>
<td>1,3,7</td>
<td>1,3,5</td>
<td>1,3,4</td>
<td>1,3,7</td>
<td>1,2,3,6</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>2,3,4,5,6</td>
<td>1,3,6,7</td>
<td>1,3,6,7</td>
<td>1,4,6,7</td>
<td>1,3,4,5,7</td>
<td>3,4,5,6</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>2,4,5,6</td>
<td>1,3,6,7</td>
<td>2,6,7</td>
<td>1,5,6,7</td>
<td>1,4</td>
<td>1,2,3,4,7</td>
<td>2,3,4,6</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>6,7</td>
<td>3,6,7</td>
<td>2,4,5,6,7</td>
<td>3,5,6,7</td>
<td>3,4,6,7</td>
<td>1,2,3,4,5,7</td>
<td>1,2,3,4,6</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>3,4,5,6,7</td>
<td>3,5,7</td>
<td>1,2,4,6,7</td>
<td>1,3,5,6,7</td>
<td>1,2,4,6</td>
<td>1,3,4,5,7</td>
<td>1,2,3,4,6</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>2,6,7</td>
<td>1,7</td>
<td>6,7</td>
<td>5,6,7</td>
<td>4</td>
<td>1,3,4,7</td>
<td>1,2,3,4,6</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>2,6</td>
<td>1,4</td>
<td>6,7</td>
<td>2,5,7</td>
<td>4,7</td>
<td>1,3,7</td>
<td>3,4,5,6</td>
<td>9</td>
</tr>
<tr>
<td>All areas</td>
<td>2,3,4,5,6,7</td>
<td>1,3,4,6,7</td>
<td>1,2,3,5,6,7</td>
<td>1,3,4,6,7</td>
<td>1,2,3,4,5,7</td>
<td>1,2,3,4,5,6,7</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Numbers shown at top of table correspond to the 7 variables and are used in the body of the table to identify variables in each of the clusters of interrelationships.

The number of pairs of significant correlations shown in the table represents a duplicated total. For example, size of farm and crop productivity are shown as having a significant correlation. In turn, crop productivity and size of farm are shown as having a significant correlation. This was presented in this manner to show readily all possible significant pairs of correlations for each variable.
and machinery in two areas; and with percent 1940 population is of the 1900 population and percent rural farm population in one area each.

Crop productivity was significantly correlated with from two to six variables; with value of implements and machinery and value of land and buildings in eight areas; with percent tenancy in five areas; with size of farm and percent 1940 population is of the 1900 population in four areas; and, with percent rural farm population in two areas.

Percent 1940 population is of the 1900 population was significantly correlated with from three to five variables; with percent rural farm population in eight areas; with value of land and buildings in six areas; with size of farm and value of implements and machinery in five areas; with crop productivity in four areas; and percent tenancy in one area.

Percent rural farm population was significantly correlated with from one to four variables; with percent 1940 population is of the 1900 population in eight areas; with size of farm in five areas; with value of land and buildings in four areas; and with value of implements and machinery, crop productivity, and percent tenancy in three, two, and one areas, respectively.

Value of implements and machinery was significantly correlated with from three to six variables; with size of farm, crop productivity, and value of land and buildings in eight areas; with percent 1940 population is of the 1900 population in five areas; and with
percent rural farm population and percent tenancy in three and two areas, respectively.

Value of land and buildings was significantly correlated with from four to six variables; with crop productivity and value of implements and machinery in eight areas; with percent 1940 population is of the 1900 population in six areas; with size of farm and percent tenancy in five areas each; and with percent rural farm population in four of the areas.

A summation of all of the significant correlations for all of the areas for each variable showed that value of land and buildings was significantly correlated with other variables 36 times out of a possible 48 significant correlations. This was followed by value of implements and machinery 34, size of farm 32, crop productivity 31, percent 1940 population is of the 1900 population 29, percent rural farm population 23, and percent tenancy 29 times.

The extent and degree of relationship between and among the variables used in the multiple regression equation to predict level of living varied markedly from area to area. The same two variable combinations of significant correlations and clusters of interdependencies shown for the state, Table 21, occurred only in area 2 for the variables size of farm and crop productivity, and in area 5 for the variables value of implements and machinery and value of land and buildings. In all other instances, the number of significant two variable correlations and the size of the clusters of
interdependencies was smaller than that for the state.

F. Summary

Analysis in this chapter has shown the soil association areas to be better adapted than type of farming areas for making gross delineations of differential level of living areas. The findings suggest fruitful possibilities for further analysis by soil types and various combinations of soil types.

While wide ranges in levels of living were found in each of the areas, the clustering of indexes within fairly narrow limits as shown by the standard deviations was evident. Homogeneity tended to prevail in the more level and less mature areas of the state, while heterogeneity tended to prevail in the more mature and more dissected areas.

In 24 of the possible 28 two-area combinations, a highly significant difference in level of living was found. Areas 1, 2 and 4 and areas 5 and 8, whose means were nearest alike, showed no significant difference. The first two areas are characterized by cash grain farming, while in the third, livestock farming predominates. All are relatively level. In areas 5 and 8 a mixed type of farming is carried on. Both are characterized by considerable dissection and both showed the greatest heterogeneity in levels of living.

Of the seven independent variables, crop productivity, value of implements and machinery and value of land and buildings showed
wide variation from area to area. All three, however, tended to show correspondingly high values in certain areas and low values in others.

In correlating each of the seven variables with level of living, crop productivity showed the highest simple correlation coefficients in six of the eight areas. In the other two, value of land and buildings showed the highest coefficients. Value of implements and machinery showed coefficients which tended to parallel those of value land and buildings, except in areas 3 and 6, where they were considerably below those of the latter. The lack of consistency from area to area in the associational relationships of the several variables with level of living was especially evident.

The multiple correlation coefficients (R) by areas ranged from .6031 to .8098. The coefficients of determination (R^2) ranged from .3637 to .6558. Thus from 36 to 66 percent of the variation in levels of living by areas was found to be associated with the independent variables.

The multiple regression analysis generally showed that combinations of different kinds of variables are needed to do an equally effective job of predicting level of living in the different areas. By areas the number of significant predictors ranged from three to six, with the largest number occurring in those areas having considerable heterogeneity in levels of living.

Among the different areas, value of land and buildings showed a significant correlation with other variables more frequently than
did any of the others. This was followed in order by value of implements and machinery, size of farm, crop productivity, percent 1940 population is of the 1900 population, percent rural farm population, and percent tenancy.

When clusters of interrelationships among the variables for each of the areas were examined, a marked shifting in composition of the clusters from area to area was noted. Variables chosen for this analysis showed the highest amount of interrelatedness in area 6 and the least in area 8.

The area to area variations in: (1) the size of correlations between levels of living and the individual variables; (2) correlations among the variables; and (3) the number of significant predictors are important considerations for future analyses of levels of living by soil areas.
VII. DELINEATION OF HOMOGENEOUS FARM FAMILY

LEVEL OF LIVING AREAS

A. Introduction

In this chapter the criterion for establishing areas is homogeneity in farm family level of living. The analysis of relationships is carried out as in the preceding chapters.

In general, areas may be classified into two types: formal and substantive. Census tracts, legal incorporations and administrative districts are examples of the first type, which arises through the imposition of formal control or formal boundary lines. The second type, substantive, is not formal or administrative in character, but results from its own internal attributes. For example, climate, soil, topography, culture, or, as with our concern, level of living in any given area differentiate it from an adjacent one.

Homogeneity indicates a similarity of attributes, or the persistence of a single factor throughout an area. A single factor may sometimes be considered as a composite. Level of living as used in this study actually is made up of several components and, separately

1 A more complete description of these two types of areas is given in Quinn, James A., Human ecology. N. Y., Prentice-Hall, Inc. 1950. p. 37-40.
or jointly, in the resulting index they reflect a whole complex of well-being.

The increasing recognition that conformity between formal and certain substantive areas would expedite handling of many types of formal organizational work and planning, emphasizes the need for extensive and intensive research in the identification and delineation of small areas homogeneous with respect to a whole complex of variables.

It was hypothesized that in homogeneous level of living areas a more consistent relationship between level of living and the variables would be observed than in the non-homogeneous level of living areas or in those established for other purposes.

B. Method of Delineation

The technique used to identify and to delineate the homogeneous level of living areas was a relatively simple one of two major steps. The level of living index of each township first was inspected to see if 13 or more contiguous townships could be found whose indexes were within an interval range of 13 index points. The number 13 was approximately one-half of the standard deviation of the level of living indexes by townships for the state. Any group of contiguous townships with fewer than 13 was arbitrarily disregarded and considered a part of the non-homogeneous portion of the state. The township within each group of townships whose farm family level of
living index was such that 12 or more contiguous additional townships could be found by use of the above interval was designated as the pivotal township. The one-half standard deviation interval yielded 20 homogeneous areas including 331 townships, or just over one-fifth of the total townships in the state. The number of townships by areas ranged from 13 to 23. Such homogeneous clusters might be expected to form symmetrical groupings about the pivotal townships. Actually the groupings took various asymmetrical shapes.

The second step was to expand the level of living interval from 13 to the full standard deviation, 27. Using the larger interval, but continuing the use of the same pivotal townships as with the one-half standard deviation interval, the expansion resulted in secondary areas to those first delineated. Some slight overlapping of areas occurred. This was resolved by assigning the overlapping townships to those areas whose pivotal township had an index value nearest their own. In this process of assigning townships to other areas, two of the 20 originally delineated core areas were eliminated, inasmuch as they were left with fewer than 13 townships each. The 18 core areas now had 304 townships to which were added 455 townships through expansion of the interval for a total of 759. The expansion added from four to 56 townships to each of the 18 core areas, resulting in combined core and secondary areas ranging in size from 18 to 74 townships. See Fig. 10. The mean was 41 townships, or the equivalent of about 2 1/2 counties per area.
In general but little conformity was noted between the areas and type of farming or principal soil association areas. The homogeneous areas included most, but not all, of the level topography of the state and but little of the dissected portions. In general, homogeneity proceeded in a broad belt from the northeast to the southwest part of the state, with the larger areas concentrating roughly in the central part of the state.

A criticism that may be advanced of the above procedure is the use of the original pivotal township for delineation of the secondary area. The assumption would be that with new pivotal townships where the interval of 27 had been substituted for that of 13, homogeneity of the areas would follow new contours. This was tried. The homogeneous areas based solely on the interval of 27 index points were found to be so nearly identical with those areas derived through first delineation of the core areas, and then of the secondary areas, that the two-step procedure was retained. The advantage of first delineating the smaller core areas was that it permitted inspection of the emerging pattern of homogeneous areas and facilitated the delineation of the secondary areas and assignment of overlapping townships. The results of this process led to the conclusion that with any other interval in level of living indexes of between 13 and 27, considerable similarity of areas would occur to those delineated.
Table 22. Number of townships in the core and secondary portions of each of the homogeneous level of living areas by appropriate level of living index interval

<table>
<thead>
<tr>
<th>Area</th>
<th>Core area level of living index interval</th>
<th>Secondary area level of living index interval</th>
<th>Total townships</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Townships</td>
<td>Townships</td>
<td>Townships</td>
</tr>
<tr>
<td>1</td>
<td>182-194</td>
<td>13</td>
<td>175-201</td>
</tr>
<tr>
<td>2</td>
<td>189-201</td>
<td>31</td>
<td>182-208</td>
</tr>
<tr>
<td>3</td>
<td>176-187</td>
<td>14</td>
<td>168-194</td>
</tr>
<tr>
<td>4</td>
<td>163-175</td>
<td>14</td>
<td>156-182</td>
</tr>
<tr>
<td>5</td>
<td>124-136</td>
<td>14</td>
<td>117-143</td>
</tr>
<tr>
<td>6</td>
<td>152-164</td>
<td>14</td>
<td>145-171</td>
</tr>
<tr>
<td>7</td>
<td>182-194</td>
<td>23</td>
<td>175-201</td>
</tr>
<tr>
<td>8</td>
<td>185-197</td>
<td>23</td>
<td>178-204</td>
</tr>
<tr>
<td>9</td>
<td>190-202</td>
<td>15</td>
<td>183-209</td>
</tr>
<tr>
<td>10</td>
<td>184-196</td>
<td>13</td>
<td>177-203</td>
</tr>
<tr>
<td>11</td>
<td>171-183</td>
<td>14</td>
<td>164-190</td>
</tr>
<tr>
<td>12</td>
<td>162-174</td>
<td>13</td>
<td>155-181</td>
</tr>
<tr>
<td>13</td>
<td>169-181</td>
<td>14</td>
<td>162-188</td>
</tr>
<tr>
<td>14</td>
<td>177-189</td>
<td>15</td>
<td>170-196</td>
</tr>
<tr>
<td>15</td>
<td>167-179</td>
<td>15</td>
<td>160-186</td>
</tr>
<tr>
<td>16</td>
<td>147-159</td>
<td>23</td>
<td>140-166</td>
</tr>
<tr>
<td>17</td>
<td>127-139</td>
<td>15</td>
<td>120-136</td>
</tr>
<tr>
<td>18</td>
<td>125-130</td>
<td>21</td>
<td>121-147</td>
</tr>
</tbody>
</table>

Total | 304 | 455 | 759

*a* Size of interval for determining the core areas was 1/2 of the standard deviation for the state. Standard deviation for the state was 27.

*b* Size of interval for core area and secondary area combined was 1 standard deviation or 27.

*c* The slight discrepancy in numbers of townships reported in this column and those shown in the areas of Fig. 10 is due to combining townships with small numbers of farms with adjacent larger townships.
Fig. 10. Homogeneous farm family level of living areas.
C. Selected Characteristics of the Homogeneous and Non-homogeneous Areas

That the homogeneous areas exhibited higher values in the variables used in the analysis than the non-homogeneous areas was a generalization supported by the data. Inspection of the data in Table 23 showed that, with the exception of size of farm, all of the means for the other variables for the aggregate of the homogeneous areas showed higher values than for the non-homogeneous area. The percent 1940 population is of the 1900 population and percent rural farm population, however, showed means only slightly in excess of those for the non-homogeneous area.

Another criterion used for deciding whether homogeneity in level of living contributed to higher values in the seven other variables was determination of the number of homogeneous areas that had variable mean values in excess of the corresponding mean value in the non-homogeneous area. With the exception of size of farm and percent 1940 population is of the 1900 population, variable by variable, comparison showed that more than half of the homogeneous areas had values in excess of the corresponding variable mean values in the non-homogeneous area. These, of course, are crude indicators of the effect of homogeneity of level of living on the variables selected for analysis with level of living, and merely give tentative description of the relationship of level of living to the variables. However, more can be learned through analysis of the relationship
Table 23. A comparison of the means of the independent variables and farm family level of living for the state; total of homogeneous areas and non-homogeneous area; and number of homogeneous areas having means equal to or above means of non-homogeneous area

<table>
<thead>
<tr>
<th></th>
<th>Size of farm, acres</th>
<th>Percent of farm land operated</th>
<th>Crop tenant productivity index</th>
<th>Percent 1940 population is of the 1900 population</th>
<th>Percent rural farm population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
<th>Farm family level of living index</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>179.2</td>
<td>51.2</td>
<td>95.6</td>
<td>91.2</td>
<td>73.0</td>
<td>$1073</td>
<td>$103</td>
<td>163.9</td>
</tr>
<tr>
<td>Homogeneous areas</td>
<td>178.1</td>
<td>53.3</td>
<td>103.2</td>
<td>91.7</td>
<td>73.3</td>
<td>$1138</td>
<td>$111</td>
<td>172.0</td>
</tr>
<tr>
<td>Non-homogeneous area</td>
<td>180.3</td>
<td>49.3</td>
<td>88.5</td>
<td>90.7</td>
<td>72.6</td>
<td>$1014</td>
<td>$96</td>
<td>155.7</td>
</tr>
<tr>
<td>Percent mean of homogeneous areas is of mean of non-homogeneous area</td>
<td>98.8</td>
<td>108.1</td>
<td>116.6</td>
<td>101.1</td>
<td>101.0</td>
<td>112.2</td>
<td>115.6</td>
<td>110.5</td>
</tr>
<tr>
<td>Number of homogeneous areas having means equal to or above mean of non-homogeneous area</td>
<td>8</td>
<td>14</td>
<td>13</td>
<td>8</td>
<td>10</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
</tbody>
</table>
of level of living to each of the variables in the two types of areas.

D. Relationship of Level of Living to Selected Social and Economic Variables

The simple variable-by-variable correlation analysis provided first approximations of the relative association of the seven variables with level of living for the aggregate of the homogeneous areas and for the non-homogeneous area. Comparison of the two sets of correlation coefficients, Table 24, showed that homogeneity in level of living had the effect of raising the correlation coefficients of the three variables, crop productivity, value of implements and machinery and value of land and buildings when correlated with level of living. Crop productivity showed the largest difference in coefficients.

The simple variable-by-variable analysis tells only part of the story. For the analysis of relationships among the seven independent variables \( x_1, x_2, x_6, x_7, x_8, x_{11} \) and \( x_{12} \) and the dependent variable level of living \( y \) a multiple regression was computed. The regression equation was:

\[
y = a + b_1x_1 + b_2x_2 + b_6x_6 + b_7x_7 + b_8x_8 + b_{11}x_{11} + b_{12}x_{12}
\]

The various beta coefficients in the equation were computed by the method of least squares. The equations for the two types of areas were as follows:
Table 24. Simple correlations between each of the variables and level of living for the combined homogeneous areas and for the non-homogeneous area

<table>
<thead>
<tr>
<th></th>
<th>Size of farm, acres</th>
<th>Percent of farm land tenant operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population is of the 1900 population</th>
<th>Percent rural farm population and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homogeneous areas</td>
<td>.13**</td>
<td>.37**</td>
<td>.85**</td>
<td>.18**</td>
<td>- .0%</td>
<td>.65**</td>
</tr>
<tr>
<td>Non-homogeneous area</td>
<td>.13**</td>
<td>.43**</td>
<td>.73**</td>
<td>.22**</td>
<td>-.07*</td>
<td>.63**</td>
</tr>
</tbody>
</table>

*Significant at the 5 percent probability level.  
**Significant at the 1 percent probability level.
homogeneous area \( y = 91.3365 + .1212x_1 - .2645x_2 + .4635x_6 
+ .0430x_7 + .0026x_8 + .0140x_{11} + .0470x_{12} \)

non-homogeneous area \( y = 81.7554 + .2038x_1 - .4457x_2 + .2839x_6 
- .0938x_7 - .1113x_8 + .0226x_{11} + .2830x_{12} \)

where \( x_1 = \) size of farm
\( x_2 = \) percent tenancy
\( x_6 = \) crop productivity
\( x_7 = \) percent 1940 population is of the 1900 population
\( x_8 = \) percent rural farm population
\( x_{11} = \) value of implements and machinery
\( x_{12} = \) value of land and buildings
\( y = \) farm family level of living.

The multiple correlation coefficient (R) for the combined homogeneous areas was .8717; for the non-homogeneous portion of the state it was .8317. Both coefficients were highly significant. In the combined homogeneous areas 76 percent of the variation in level of living was associated with the independent variables; in the non-homogeneous area, it was 69 percent. The difference between the two coefficients also was highly significant. This tended to support the hypothesis that in the homogeneous level of living areas a more consistent relationship between level of living and the variables will be observed than in the non-homogeneous level of living area. The hypothesis then follows that somewhat different sets of variables are needed to do an equally effective job of predicting level of living in the two types of areas.
determination, and standard partial regression coefficients areas and the non-homogeneous area

<table>
<thead>
<tr>
<th>$b_{16}$</th>
<th>$b_{17}$</th>
<th>$b_{18}$</th>
<th>$b_{19}$</th>
<th>$b_{11}$</th>
<th>$b_{12}$</th>
<th>$t_{11}$</th>
<th>$t_{12}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.27**</td>
<td>0.064</td>
<td>3.00**</td>
<td>0.14</td>
<td>0.213</td>
<td>8.11**</td>
<td>0.074</td>
<td>1.89</td>
</tr>
<tr>
<td>7.78**</td>
<td>-0.123</td>
<td>5.29**</td>
<td>-0.096</td>
<td>4.47**</td>
<td>0.399</td>
<td>15.12**</td>
<td>0.359</td>
</tr>
</tbody>
</table>
The contribution of each of the seven independent variables was determined through a standard partial regression analysis by partialing out six of the seven factors at a time to determine the existing relationship between level of living and any single factor playing upon it when the other 11 variables were held constant. Table 25 shows: (1) the standard partial regression coefficients ($b'$) for the seven variables; (2) their corresponding ($t$) values; and (3) whether or not significant.

For the combined homogeneous areas five of the seven independent variables were found to be significant at the 1 percent probability level. The non-significant variables were percent rural farm population and the value of land and buildings. For the non-homogeneous portion of the state all seven independent variables were found to be highly significant.

It will be recalled that for the state five of the seven variables were significant at the 1 percent probability level. The non-significant variables were percent 1940 population is of the 1900 population and percent rural-farm population. It is evident that for the state, for the combined homogeneous areas and for the non-homogeneous portion of the state the variables differed in their ability to predict level of living.

In the following two tables, 26 and 27, are shown the intercorrelations for the combined homogeneous areas and for the non-homogeneous portion of the state.
<table>
<thead>
<tr>
<th>Size of Farm, acres</th>
<th>1,000</th>
<th>69.00</th>
<th>17.00</th>
<th>20.00</th>
<th>5.27</th>
<th>6.00</th>
<th>5.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of farm land operated</td>
<td>0.19</td>
<td>0.21</td>
<td>0.22</td>
<td>0.23</td>
<td>0.24</td>
<td>0.25</td>
<td>0.26</td>
</tr>
<tr>
<td>Population of farm</td>
<td>19.00</td>
<td>19.00</td>
<td>19.00</td>
<td>19.00</td>
<td>19.00</td>
<td>19.00</td>
<td>19.00</td>
</tr>
<tr>
<td>Tenant, farm and productive</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Value of farm and productive</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Value of farm and productive</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Value of farm and productive</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Value of farm and productive</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Value of farm and productive</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Value of farm and productive</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Equation for the combined homogeneous groups

Table 26. Intercoefficients among the variables used in the multiple regression
Table 27. Intercorrelations among the variables used in the multiple regression equation for the combined non-homogeneous area

<table>
<thead>
<tr>
<th>Size of farm, acres</th>
<th>Percent of farm land tenant operated</th>
<th>Crop productivity index</th>
<th>Percent 1940 population is rural farm population</th>
<th>Percent 1940 population of the 1900 population</th>
<th>Value of implements and machinery per 100 acres</th>
<th>Value of land and buildings per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of farm, acres</td>
<td>1.00</td>
<td>.28</td>
<td>.14</td>
<td>-.11</td>
<td>.15</td>
<td>-.19</td>
</tr>
<tr>
<td>Percent farm land tenant operated</td>
<td>.28</td>
<td>1.00</td>
<td>.69</td>
<td>.18</td>
<td>-.01</td>
<td>.37</td>
</tr>
<tr>
<td>Crop productivity index</td>
<td>.14</td>
<td>.69</td>
<td>1.00</td>
<td>.24</td>
<td>-.04</td>
<td>.52</td>
</tr>
<tr>
<td>Percent 1940 population is of the 1900 population</td>
<td>-.11</td>
<td>.18</td>
<td>.24</td>
<td>1.00</td>
<td>-.36</td>
<td>.40</td>
</tr>
<tr>
<td>Percent rural farm population</td>
<td>.15</td>
<td>-.01</td>
<td>-.04</td>
<td>-.36</td>
<td>1.00</td>
<td>.00</td>
</tr>
<tr>
<td>Value of implements and machinery per 100 acres</td>
<td>-.19</td>
<td>.37</td>
<td>.52</td>
<td>.40</td>
<td>.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Value of land and buildings per acre</td>
<td>-.12</td>
<td>.51</td>
<td>.83</td>
<td>.35</td>
<td>-.11</td>
<td>.61</td>
</tr>
</tbody>
</table>

Significant values are .05 to .10. Those of .11 and above are highly significant, d.f. = 826.
Out of a possible 21 significant and/or highly significant correlations, there were 17 and 18 by the two types of areas, respectively. In each of the two types of areas seven clusters of interdependencies occurred. Only those variables having significant or highly significant correlation coefficients were used in determining the clusters. The clusters for the combined homogeneous areas ranged from five to seven variables each, and for the non-homogeneous portion of the state, from four to seven variables. A number of the interrelationships were relatively high. About 24 percent of the interrelationships in the combined homogeneous areas were negatively associated, while in the non-homogeneous portion of the state 33 percent were negatively associated.

A summation of the significant correlations for combined homogeneous areas showed that percent tenancy was significantly correlated with other variables six times out of a possible six correlations. This was followed by size of farm, crop productivity, value of implements and machinery and value of land and buildings five, and percent 1940 population is of the 1900 population and percent rural farm population four times.

In the non-homogeneous area, size of farm, percent 1940 population is of the 1900 population and value of land and buildings were significantly correlated with other variables six times out of a possible six correlations. This was followed by percent tenancy, crop productivity and value of implements and machinery five, and percent rural farm population three times.
The same two-variable combinations of significant correlations and clusters of interdependencies for the state, Table 21, occurred in the combined homogeneous areas only for the variable crop productivity. In the non-homogeneous area they occurred for size of farm, percent tenancy, percent 1940 population is of the 1900 population and value of land and buildings. This appears to indicate that the interrelationship behavior of the variables in the combined homogeneous areas differed markedly from that in the non-homogeneous area or in the entire state. Introducing homogeneity reduced: (1) the number of significant standard partial regression coefficients; (2) the number of significantly paired combinations; and (3) the size of the clusters of significant interrelationships compared to those of the non-homogeneous area and those of the state.

E. Summary

Analysis of farm family level of living and its association with other variables by the combined homogeneous level of living areas and the non-homogeneous portion of the state has indicated another technique that may be used in the identification and delineation of the ecological patterns of levels of living or of any other variable.

The homogeneous level of living areas as identified for Iowa do not conform closely to type of farming or principal soil association areas. In general, the areas include most of the level topography
Table 28. Clusters of significant interrelationships among the seven variables used in the multiple regression equation for the combined homogeneous areas and for the non-homogeneous area

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Size of farm, acres</td>
<td>Percent of farm land operated</td>
<td>Crop productivity index</td>
<td>Percent 1940 population is rural farm population</td>
<td>Percent 1900 agriculture population</td>
<td>Value of land and ceded total machinery for 100 acres</td>
</tr>
<tr>
<td>Homogeneous areas</td>
<td>6</td>
<td>2, 3, 4, 5</td>
<td>1, 3, 5, 6, 7</td>
<td>1, 2, 4, 6, 7</td>
<td>1, 2, 5, 6, 7</td>
<td>1, 2, 3, 7</td>
<td>1, 2, 3, 4, 7</td>
</tr>
<tr>
<td>Non-homogeneous area</td>
<td>6, 7</td>
<td>2, 3, 4, 5</td>
<td>1, 3, 4, 6, 7</td>
<td>1, 2, 4, 6, 7</td>
<td>1, 2, 3, 5, 6, 7</td>
<td>1, 4, 7</td>
<td>1, 2, 3, 4, 7</td>
</tr>
</tbody>
</table>

a Numbers shown at top of table correspond to the seven variables and are used in the body of the table to identify variables in each of the clusters of interrelationships.

b The number of pairs of significant correlations shown in the table represents a duplicated total. For example, size of farm and crop productivity are shown as having a significant correlation. In turn, crop productivity and size of farm are shown as having a significant correlation. This was presented in this manner to show readily all possible significant pairs of correlations for each variable.
of the state and avoid most of the dissected portion. The larger areas tend to be concentrated in the central part of the state. Homogeneity tends to proceed in a broad belt from northeast to southwest.

As additional data becomes available additional research should be undertaken to further validate the areas delineated here and particularly to unfold areas that are homogeneous with respect to large complexes of internal attributes. Because of its small size the township seems well adapted to use in the identification and delineation of such areas.

Analysis has shown that in Iowa generally the higher mean levels of living are found in those areas which are relatively homogeneous with respect to levels of living, while the lower mean levels are found in the non-homogeneous portion of the state.

Six of the seven variables showed higher mean values in the combined homogeneous areas than in the non-homogeneous portion of the state.

Three of the seven variables, crop productivity, value of implements and machinery and value of land and buildings when correlated with level of living showed higher simple correlation coefficients in the homogeneous area than in the non-homogeneous area. Other variables showed either equal or lower correlation coefficients.

The multiple correlation coefficients (R) for the two areas were .8717 and .8317, respectively. The difference was statistically highly significant. The coefficients of determination (R²) were
76 and 69 percent, respectively. This led to the conclusion that the variables used in this analysis do a better job of predicting level of living in the homogeneous rather than in the non-homogeneous portion of the state.

The fact that the five highly significant standard partial regression coefficients in the combined homogeneous areas did a better job jointly than did the seven highly significant coefficients in the non-homogeneous area of predicting level of living suggests that fewer variables may be used to account for variations in level of living in homogeneous than in non-homogeneous level of living areas.

The clusters of interrelationships among the significant variables showed some shifting in the composition of the clusters from one type of area to the other. In the non-homogeneous area four of the seven clusters conformed to those found for the state as a whole while only one did so in the homogeneous areas.
VIII. ECOLOGY OF FARM FAMILY LEVEL OF LIVING
AND SELECTED SOCIAL AND ECONOMIC VARIABLES

A. Introduction

This study has been concerned with analyses of farm family level of living and related variables, proceeding from an overall analysis for the entire state to one by type of farming areas, by principal soil association areas, and by homogeneous and non-homogeneous level of living areas. The methods and techniques illustrated only in gross manner the location of small areas in which a close relationship existed between each of the variables and level of living.

The analysis in this chapter centers around an attempt to show geographically, township by township, where in Iowa there was general correspondence in the rank of level of living in relation to each of the variables. The technique combined both statistical data and mapping.

B. Ranking of the Data

The first step in this analysis was to group the data for all the variables. The six level of living index intervals, as employed previously, were used as the control for grouping the other seven variables. The level of living index intervals and number of
townships in each were as follows:

<table>
<thead>
<tr>
<th>Intervals</th>
<th>Number of townships</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 120</td>
<td>106</td>
</tr>
<tr>
<td>120-139</td>
<td>201</td>
</tr>
<tr>
<td>140-159</td>
<td>346</td>
</tr>
<tr>
<td>160-179</td>
<td>436</td>
</tr>
<tr>
<td>180-199</td>
<td>386</td>
</tr>
<tr>
<td>200 and over</td>
<td>111</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,586</strong></td>
</tr>
</tbody>
</table>

The values for each of the variables were arrayed from low to high. Starting with the lowest value in each of the arrays, 106 township values were counted. An arbitrary interval break was established between the 106th and the 107th values, followed by counting the next 201 township values and establishing the next interval, and so on through the six intervals. The level of living intervals, with the exception of the lowest and highest, were of equal size; for the other variables the range in the intervals differed.

In the process of establishing intervals for the seven variables, certain township variable values falling in the array at the terminal points of an interval arbitrarily were assigned to the one just above or just below in order to complete the required number of values in each. When this was done, consideration was given to the ranking of all other values of the particular township. In this
manner a minimum of bias was introduced. After all of the values were grouped, it was then possible to see how any stated township in a given level of living index interval ranked with respect to the other variables. If a township variable value fell into the same interval with that of level of living, then it was considered as closely associated with level of living.

C. Method of Mapping Ranked Data

Having determined whether or not the township variable values \(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}, x_{11},\) and \(x_{12}\) were in the corresponding interval with the level of living index interval, the information was placed in the following manner on an outline map of Iowa showing all townships. Intervals were assigned numbers from one to six. If the level of living in a township ranked in the third interval and crop productivity for the same township also ranked in the third interval, that information was placed on a work map in the appropriate township as 3-3. Other townships may have had rankings of 1-3, 4-5, 5-5, 5-2, etc. The first number always denoted the level of living rank, the second the variable rank. Having completed this step, townships, or groups of townships, showing individual variables in general correspondence with level of living were identifiable. Also it was possible to see the degree of general correspondence between level of living and any other variable. Differences ranged from none to as many as five intervals. In some townships level of living
ranked in higher intervals than did the variable under comparison, and vice versa. This had the effect of showing a lead or lag relationship between level of living and any single variable in any township.

Tables 29 to 35 are presented to show how the several variables distributed themselves in relation to level of living. Table 36 is presented also to show the number of townships that had variable values in corresponding intervals with the level of living index intervals.

It is apparent from Table 36 that correspondence within a number of townships between each variable and level of living did not conform closely with the simple correlations. It will be noted in Table 35 that for the value of land and buildings, 722 townships, or a little more than 45 percent of the total, were in the same interval level with respect to this variable as they were for level of living. This sum was obtained by adding diagonally across the table from the upper left hand corner to the lower right hand corner. In the case of crop productivity, there were 699, or 44 percent of the townships. For the other variables the numbers were smaller. While practically no correlation was shown between level of living and percent rural farm population, 37 1/4 townships had values for this variable which fell in the same corresponding intervals as they did for level of living.

The rank or degree of correspondence of level of living by townships in relation to each of the seven variables is shown in Figures
Table 29. Rank distribution of townships by farm family level of living and size of farm

<table>
<thead>
<tr>
<th>Level of living index intervals</th>
<th>Number of townships by size of farm</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Under 137</td>
<td>137-155</td>
</tr>
<tr>
<td>Under 120</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>120 - 139</td>
<td>21</td>
<td>32</td>
</tr>
<tr>
<td>140 - 159</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>160 - 179</td>
<td>32</td>
<td>63</td>
</tr>
<tr>
<td>180 - 199</td>
<td>17</td>
<td>38</td>
</tr>
<tr>
<td>200 and over</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
<td>201</td>
</tr>
</tbody>
</table>
Table 30. Rank distribution of townships by farm family level of living and percent of land tenant operated

<table>
<thead>
<tr>
<th>Level of living index interval</th>
<th>Number of townships by percent of land tenant operated</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Under 34</td>
<td>34-42</td>
</tr>
<tr>
<td>Under 120</td>
<td>25</td>
<td>34</td>
</tr>
<tr>
<td>120 - 139</td>
<td>25</td>
<td>46</td>
</tr>
<tr>
<td>140 - 159</td>
<td>35</td>
<td>67</td>
</tr>
<tr>
<td>160 - 179</td>
<td>13</td>
<td>37</td>
</tr>
<tr>
<td>180 - 199</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>200 and over</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
<td>201</td>
</tr>
</tbody>
</table>
Table 31. Rank distribution of townships by farm family level of living and crop productivity

<table>
<thead>
<tr>
<th>Level of living index interval</th>
<th>Number of townships by crop productivity index</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 120</td>
<td>61, 27, 13, 5, 0, 0</td>
<td>106</td>
</tr>
<tr>
<td>120 - 139</td>
<td>32, 85, 63, 18, 3, 0</td>
<td>201</td>
</tr>
<tr>
<td>140 - 159</td>
<td>11, 75, 137, 96, 26, 1</td>
<td>346</td>
</tr>
<tr>
<td>160 - 179</td>
<td>2, 11, 115, 188, 102, 18</td>
<td>436</td>
</tr>
<tr>
<td>180 - 199</td>
<td>0, 2, 17, 123, 190, 54</td>
<td>386</td>
</tr>
<tr>
<td>200 and over</td>
<td>0, 1, 1, 6, 65, 38</td>
<td>111</td>
</tr>
<tr>
<td>Total</td>
<td>106, 201, 346, 436, 386, 111</td>
<td>1,586</td>
</tr>
</tbody>
</table>
Table 32. Rank distribution of townships by farm family level of living and percent 1940 population is of the 1900 population

<table>
<thead>
<tr>
<th>Level of living index interval</th>
<th>Number of townships by percent 1940 township population is of the 1900 population</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Under 62</td>
<td>62-71</td>
</tr>
<tr>
<td>Under 120</td>
<td>39</td>
<td>27</td>
</tr>
<tr>
<td>120 - 139</td>
<td>26</td>
<td>47</td>
</tr>
<tr>
<td>140 - 159</td>
<td>21</td>
<td>57</td>
</tr>
<tr>
<td>160 - 179</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>180 - 199</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>200 and over</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
<td>201</td>
</tr>
</tbody>
</table>
### Table 33. Rank distribution of townships by farm family level of living and percent rural farm population

<table>
<thead>
<tr>
<th>Level of living index</th>
<th>Under 31</th>
<th>31-47</th>
<th>48-69</th>
<th>70-94</th>
<th>95 and over</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 120</td>
<td>3</td>
<td>9</td>
<td>22</td>
<td>34</td>
<td>38</td>
<td>106</td>
</tr>
<tr>
<td>120 - 139</td>
<td>12</td>
<td>21</td>
<td>51</td>
<td>50</td>
<td>67</td>
<td>201</td>
</tr>
<tr>
<td>140 - 159</td>
<td>27</td>
<td>33</td>
<td>73</td>
<td>95</td>
<td>118</td>
<td>346</td>
</tr>
<tr>
<td>160 - 179</td>
<td>33</td>
<td>66</td>
<td>92</td>
<td>124</td>
<td>121</td>
<td>476</td>
</tr>
<tr>
<td>180 and overa</td>
<td>31</td>
<td>72</td>
<td>108</td>
<td>133</td>
<td>153</td>
<td>497</td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
<td>201</td>
<td>346</td>
<td>436</td>
<td>497</td>
<td>1,586</td>
</tr>
</tbody>
</table>

*a For this variable the fifth and sixth intervals have been combined. The number of townships with 100 percent rural farm population was too large for proper allocation between the 180-199 and the 200 and over intervals.*
Table 34. Rank distribution of townships by farm family
level of living and value of implements and
machinery per 100 acres

<table>
<thead>
<tr>
<th>Level of living index interval</th>
<th>Under $535</th>
<th>535-757</th>
<th>758-1005</th>
<th>1006-1239</th>
<th>1240-1569</th>
<th>1570 and over</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 120</td>
<td>54</td>
<td>33</td>
<td>14</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>106</td>
</tr>
<tr>
<td>120 - 139</td>
<td>31</td>
<td>78</td>
<td>63</td>
<td>23</td>
<td>6</td>
<td>-</td>
<td>201</td>
</tr>
<tr>
<td>140 - 159</td>
<td>15</td>
<td>62</td>
<td>128</td>
<td>92</td>
<td>43</td>
<td>6</td>
<td>346</td>
</tr>
<tr>
<td>160 - 179</td>
<td>4</td>
<td>21</td>
<td>95</td>
<td>172</td>
<td>115</td>
<td>29</td>
<td>436</td>
</tr>
<tr>
<td>180 - 199</td>
<td>2</td>
<td>6</td>
<td>39</td>
<td>120</td>
<td>173</td>
<td>46</td>
<td>386</td>
</tr>
<tr>
<td>200 and over</td>
<td>-</td>
<td>1</td>
<td>7</td>
<td>27</td>
<td>46</td>
<td>30</td>
<td>111</td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
<td>201</td>
<td>346</td>
<td>436</td>
<td>386</td>
<td>111</td>
<td>1,586</td>
</tr>
</tbody>
</table>
## Table 35. Rank distribution of townships by farm family level of living and per acre value of land and buildings

<table>
<thead>
<tr>
<th>Level of living index interval</th>
<th>Number of townships by per acre value of land and buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Under 50</td>
</tr>
<tr>
<td>Under 120</td>
<td>62</td>
</tr>
<tr>
<td>120-139</td>
<td>31</td>
</tr>
<tr>
<td>140-159</td>
<td>10</td>
</tr>
<tr>
<td>160-179</td>
<td>2</td>
</tr>
<tr>
<td>180-199</td>
<td>-</td>
</tr>
<tr>
<td>200 and over</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>106</td>
</tr>
</tbody>
</table>
Table 36. Distribution of townships showing by variables number which corresponded with level of living intervals; totals and percent of total of all townships; and, simple correlation between level of living and variables

<table>
<thead>
<tr>
<th>Level of living index</th>
<th>Number of townships by variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level of Size of farm, Percent of farm land operated, Crop productivity index, Percent 1940 population is rural farm population, 1900 population, Value of implement and machinery per 100 acres, Value of land and buildings per acre</td>
</tr>
<tr>
<td>Interval</td>
<td>index</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Under 120</td>
<td>106</td>
</tr>
<tr>
<td>120-139</td>
<td>201</td>
</tr>
<tr>
<td>140-159</td>
<td>346</td>
</tr>
<tr>
<td>160-179</td>
<td>436</td>
</tr>
<tr>
<td>180-199</td>
<td>386</td>
</tr>
<tr>
<td>200 and over</td>
<td>111</td>
</tr>
<tr>
<td>Total</td>
<td>1,586</td>
</tr>
<tr>
<td>Percent of total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Simple correlations between level of living and variables

- .11
- .44
- .78
- .20
- .05
- .53
- .75

*For this variable the fifth and sixth intervals have been combined. The number of townships with 100 percent rural farm population was too large for proper allocation between the two intervals.
ll to 17. The maps represent a simplification of the data in the tables, since only three types of townships are identified: (1) those in which level of living and the variable in question were in general correspondence; (2) those in which level of living ranked below the variable regardless of whether by one or more intervals; and (3) those in which level of living ranked above the variable by one or more intervals. Ideally, maps should show all degrees of correspondence. Because the large number of interval combinations not only would increase the complexity of such maps, but make reading on a reduced scale very difficult, it was considered inadvisable to include them in this study.

While the tables provided useful statistical information, the maps located such information in geographic place. Inferences and interpretations from the statistical tables can be supplemented with those made from the maps.

D. Discussion of the Results

Although a relatively high correlation coefficient of .75 existed between level of living and crop productivity, that association was not present uniformly throughout the state as shown in Fig. 13. In the western part of the state, farm family level of living tended to rank below that of crop productivity, while in the eastern part of the state level of living ranked above. In the latter portion of the state, dairying and livestock feeding operations contribute more
Fig. 11. Rank of farm family level of living in relation to size of farm, by townships
Fig. 12, Rank of farm family level of living in relation to percent of farm land tenant operated, by townships
Fig. 13. Rank of farm family level of living in relation to crop productivity, by townships
Fig. 1h. Rank of farm family level of living in relation to percent 1940 population is of the 1900 population, by townships.
Fig. 15. Rank of farm family level of living in relation to percent rural farm population, by townships
Fig. 16. Rank of farm family level of living in relation to value of implements and machinery per 100 acres, by townships.
Fig. 17. Rank of farm family level of living in relation to value of land and buildings per acre, by townships
heavily to the farm family's income than crop productivity. In
the southern part of the state level of living and crop productivity
maintained a relatively close relationship.

Somewhat similar to level of living and crop productivity,
townships showing both level of living and value of land and build-
ings in the same rank, Fig. 17, were fairly well distributed over
the entire state. However, it should be noted that townships with
a level of living rank higher than that of valuation of land and
buildings tended to be located in the eastern half of the state,
while in the western half of the state there was some tendency
toward the opposite situation.

The relationship of level of living to value of implements and
machinery depicted in Fig. 16 showed a pattern somewhat different
from that of value of land and buildings or crop productivity. In
northeast Iowa the rank of level of living tended to lag behind that
of value of implements and machinery. The implication follows that
it is necessary proportionally for the families to capitalize heavily
in the mechanical means of production in order to maintain a reason-
able level of living. In the remainder of the state, with the excep-
tion of small interspersed areas, level of living ranked equal to
or above that of the value of implements and machinery. Concentra-
tions of townships in which level of living ranked higher were
located just east of the central part of the state, in the western
and northwestern and in the southern parts of the state. Livestock
raising and feeding tends to prevail in most such areas.
Generally called the higher rank were those drifted earlier, and
those during the 1940 period. The areas in which level of living
were considerably above average that occurred in the urban part-
show here between farm family level of living and total population

Introducing urban as well as rural, therefore, the relationship
1900 population. The population transformation was for total population
to rank lower than the rank of percent the 1940 population is of the
and southern portions of the state showed that level of living tended
population. Similarly, areas near the northeastern, northerm, western
state ranked higher than percent the 1940 population is of the 1900
there are substantial concentrations of families in which level of
which in most central, central, west central and southwestern Iowa
that is or the 1900 population is dependent in fig. 11. This showed
the relationship of level of living to percent the 1940 population

The relationship was shown, correspondence between them was not
where for the state as a whole, a much higher percent ranked higher than level of living
percent of land tenant operated are generally higher than percent
shyp. In much of the western and southern part of the state, percent
central western part of the state tended to show a similar relation-
percent in central and eastern Iowa were generally higher than percent
of land tenant operated, the north central and western Iowa ranked
level of living or farm land tenant operated, level of living
In an examination of the, it is shown the relationship of level
the state of Iowa.

The data presented in the table and the graphs show that the note-taking ratios are generally higher in the southern and eastern parts of the state, while the note-taking ratios in the northwestern and north central parts of the state are lower. The note-taking ratios in the southeastern part of the state are the highest, followed by those in the southwestern part. The note-taking ratios in the northwestern part of the state are the lowest.

The note-taking ratios in the state of Iowa have been consistent over many years. The note-taking ratios in western Iowa have been higher than those in eastern Iowa. The note-taking ratios in the southeastern part of the state have been consistently higher than those in the northwestern part of the state. The note-taking ratios in the central part of the state have been the lowest.
had corresponding level of living and percent rural farm population ranks. Similar to the distribution of the level of living indexes by townships, Fig. 1, the northeastern, southern and western parts of the state showed percent rural farm population generally ranking higher than level of living. This may be expected, for these areas with few centers in the urban classification and as a consequence they have high percentages of the population in the rural classifications. It also indicated that a high degree of rurality does not necessarily carry with it a high level of living.

The general interpretation warranted is that level of living ranks usually were correspondingly higher in those areas characterized by something less than a completely rural population. Determination of the effect of the presence of an urban population in those townships where such was present was not undertaken in this study. The hypothesized positive relationship however, was suggested by the mapped ranks of level of living in relation to percent rural farm population.

E. Summary

The areas of association and dissociation between level of living and each of the seven variables have been observed and discussed. The technique used for showing such association and dissociation has demonstrated the general lack of uniformity of concentration throughout the state of similar ranks between level of living and each of the
variables. This effort can only serve to indicate the large amount of research needed to find any sizeable number of variables which, when associated with farm family level of living, will result in similar areas of concentration.

The identification of such areas has definite implication for various types of research and the structuring and evaluation of programming activities designed to further improve the well-being of the farm people socially and economically.

The advantages of the mapping procedure was that of pointing out in geographic space the location of townships showing general correspondence between level of living and each of the variables taken independently of the others. While correlation coefficients computed for the combined townships of the state gave an indication of the degree of association between level of living and each of the variables, they lacked the ability to identify townships in which such association may be expected. The coefficients, however, did provide an indication of whether such correspondence in ranks could be expected between level of living and each of the variables.
IX. SUMMARY AND CONCLUSIONS

Several techniques for analyzing farm family level of living and related factors in Iowa have been outlined and presented. Basically, the employment of the techniques and the analyses were exploratory. They involved the study of farm family levels of living on a state basis, type of farming area basis, principal soil association area basis, homogeneous level of living area basis and included a determination of the ecological relationship of level of living to each of seven variables. Analyses of the relationship of levels of living to the variables on the state, soil association and homogeneous level of living area bases were made. An analysis of change in levels of living 1940 to 1945 also was made.

All of the data were obtained from published and unpublished secondary sources, including data from the federal census, from assessors' records, from publications and files of the Bureau of Agricultural Economics, U. S. D. A., and from publications and files of the Department of Economics and Sociology, Iowa State College.

The thesis underlying this exploratory effort is that despite the general impression that farm families in Iowa have a high level of living, wide variations are to be found. Corollary to this is that any level of living is the product of many interacting variables and that the interactive patterns will vary from area to area.
The development and availability of farm family level of living indexes by townships suggested the possibility of exploratory work toward effectively delineating areas which more adequately represent the product of local physical, social and economic conditions than do the county indexes. Indexes by townships are fairly sensitive indicators of the differences within counties or other areas and generally are adaptable to analysis by areas having irregular configurations, to identification of homogeneous and non-homogeneous level of living areas, and to description and analysis of the township by township relationship of level of living to other variables.

In the analysis of areas within the state, this study started out with type of farming areas as a point of departure. Significant differences in levels of living were indicated mainly between Southern Pasture and each of the other four areas. While of considerable value in analyzing farm conditions, the type of farming areas did not appear well adapted for use in level of living analysis.

The assumption that soil association areas differentiate levels of living had a reasonable amount of support from this analysis. Homogeneity in levels of living was more prevalent in those areas characterized by a level topography than in the dissected areas. In each soil association, the clustering of indexes within fairly narrow limits was indicative of the propensity to homogeneity in levels of living on an area basis.

Areas of contiguous townships delineated solely on the basis of homogeneity in levels of living were found to lack close conformity
with either type of farming areas or soil association areas. Homogeneity was found to proceed, for the most part, in a broad belt from northeast to southwest Iowa and to include most of the level topography of the state. In general, higher levels of living and higher values for most of the variables prevailed in the homogeneous rather than in the non-homogeneous part of the state.

The ecological delineation of the correspondence between farm family level of living and the seven variables indicates areas in the state where a close association exists between level of living and each of the variables. The mapping of these relationships provided a technique whereby association and dissociation may be identified in place. In general, the variables showing the highest statistical relationship with level of living also resulted in the largest number of townships on the map showing the close association.

The relationships between level of living and the variables were determined by means of simple correlations, multiple correlation and multiple regression analyses. Generally and irrespective of the type of area, crop productivity was found to be most closely related to level of living with values of land and buildings, value of implements and machinery, and percent tenancy following in that order. Other variables showed relationships of lower magnitude.

A regression equation using size of farm, percent tenancy, crop productivity, percent 1940 population is of the 1900 population, percent rural farm population, value of implements and machinery and value of land and buildings was found to be highly correlated on a
state basis with farm family level of living \((R = .81)\). By soil association areas the correlations \((R)\) ranged from .60 to .81. For the homogeneous and non-homogeneous areas the correlations \((R)\) were .67 and .83, respectively.

Standard partial regression analyses using the seven variables showed that crop productivity and farm size were consistently significant predictors of level of living regardless of type of areas considered. These variables were followed closely by value of implements and machinery and value of land and buildings. In about half of the areas, percent tenancy and percent 1940 population is of the 1900 population had significant coefficients. Percent rural farm population was the least important.

The lack of consistency in number and kind of significant variable predictors of level of living from area to area is of special importance to all persons, groups and agencies concerned with the welfare of the farm population. With further duplication of this study or of various aspects of it, more adequate guidance in the different areas of the state could be given to various activities with which farm people are concerned.

The limited availability of statistical measures on a township basis for many pertinent social and economic variables was perhaps the most serious problem in this study. However, with the publication of the 1950 federal census most of the data appearing in published form for counties also will be available for townships either in published or unpublished form. Consequently in future researches
greater choice in variables suitable for determination of areas and
for relationship analyses will be possible.

Contributions of the study were: (1) a demonstration of the
usefulness of the farm family level of living indexes by townships
to indicate the existent wide variations in and uniform concentra-
tions of levels of living; (2) the adaptation of township indexes to
analysis by soil association or any other areas with irregular
contours; (3) identification and delineation of small homogeneous
level of living areas by use of indexes; (4) the usefulness of the
indexes in mapping township by township the relationship of rank of
level of living and that of each of the variables; (5) the deter-
mination of the lack of consistency from area to area in the
associational relationship of the several variables to level of
living; and (6) the determination of the differences in ability of
variables to predict level of living from area to area.

Other investigations might well include: (1) a further valida-
tion of the relationship of soil associations and particularly soil
types to levels of living; (2) further validation of the homogeneous
level of living areas and an analysis of their unique characteristics
with some experimentation to determine their usefulness as areas for
other types of social and economic research; (3) attempts to delineate
areas which are homogeneous with respect to large complexes of
internal attributes including level of living; (4) studies of level
of living time series data by areas and the relationship of change
in levels of living to that of related variables; (5) determination
The effects of educational programs for improving level of attainment and prediction level of attainment are the same: (6) demonstration of achievement over time in level of attainment and

X. LITERATURE CITED


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