INDEXES OF THE INFLUENCE OF WEATHER ON AGRICULTURAL OUTPUT

Thesis for the Degree of Ph. D.

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James Larkin Stallings

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This is to certify that the

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INDEXES OF THE INFLUENCE OF WEATHER ON AGRICULTURAL OUTPUT

By

James Larkin Stallings

AN ABSTRACT

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Approved Glenn L Johnson

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ABSTRACT

James Larkin Stallings

In this thesis indexes of the influence of weather on yields of corn, oats, barley, wheat, soybeans, cotton, and tobacco are constructed. Indexes are also constructed for the influence of weather on some important aggregate measures of U. S. agricultural production and yields including the indexes of Crop Production, Gross Farm Production, Farm Output, Marketings and Home Consumption, and Crop Yields per Harvested Acre. In addition, indexes were constructed for the feed grain components of the indexes of Crop Production, Farm Output, Marketings and Home Consumption, and Yields per Harvested Acre.

These indexes of the influence of weather were computed from time series of experimental plot data for the various crops located in the more concentrated areas of production. Series were obtained where as many variables as possible had been constant. The general procedure was as follows:

1. Trend was removed from each separate series for each crop at each location by fitting a linear regression line to the data. This was done to remove the influence of increases or decreases in soil fertility due to the particular treatment for each experimental plot.
2. Indexes for each series were computed as the ratio of the actual to the computed yields.
3. Indexes for each series for each crop at each location were averaged for overlapping years to get an index for each crop at each location.

4. Indexes for each crop at each location were weighted together into an index for the particular crop for the United States using average production for the area to be represented by the index at each location during the base period 1947-49.

5. Indexes for the seven crops were weighted together into indexes of the influence of weather on various aggregate measures of production and yields using value of production during the base period 1947-49. The Indexes of Range Conditions as presented in various U.S.D.A. publications were also combined into an index and used in two cases.

An evaluation of the sixteen indexes by various formal and informal techniques indicated that, in all but two cases, variations in the U. S. average yields of the seven crops and in the indexes of the various aggregate measures were highly associated with variations in the respective weather indexes. There was also an indication that an important amount of the variation in these crop yields and aggregate production and yield measures was due to the influence of weather. It was concluded that all but two of the indexes of the influence of weather are valuable measures to include in various econometric models where a weather variable is needed; and to use in a less formal manner to help explain and hypothesize about various relationships.

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CHAPTER I

INTRODUCTION

This thesis reports an attempt to measure the influence of weather on the yields of specific crops and various aggregate measures of agricultural production and yields. The purpose is to aid and improve analysis and estimation of economic relationships in agriculture. The need for a study of this type was brought to the author's attention primarily in connection with a study being carried on at the Michigan Agricultural Experiment Station, now completed, by W. A. Cromarty.[1] The objectives of that project were to specify and compute quantitative measurements of the structural economic relationships present in the agricultural sector of the economy. The two main purposes were "to contribute to economic models which are being developed at the University of Michigan by specifying in more detail the role which agriculture plays and to aid in agricultural outlook work." Categories of commodities studied by Cromarty included wheat, feed grains, soybeans, tobacco, cotton, dairy, beef cattle, hogs, eggs, poultry meats, potatoes and truck crops and all remaining commodities as a group. Cromarty

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1. Cromarty, W. A., Economic Structure in American Agriculture, Unpublished Ph.D. Thesis, Michigan State University, 1957.

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specified the relationships he believed to hold for these commodities in the form of simultaneous equations for price and supply. In his models for supply of wheat, feed grains, soybeans, tobacco, and cotton, one of his predetermined variables included some measure of weather. In a preliminary report on his project,[1] he had this to say: "While it is realized that a separate study concentrated on the influence of weather on yields should be undertaken, such a study will not be completed in time to be an integral part of this model. Adjustments may be made at a later date." His suggestion for the approach to this weather study was: "to cooperate with state experiment stations in getting plot yield data on specific crops. If fairly constant production techniques have been employed in growing like varieties of a crop over a period of years, the effect of yield changes could be attributed to weather. Area data could be compiled and aggregated to get a national series. It is believed that such an approach is to be preferred to using specific climatic variables such as temperature or rainfall at critical periods. However, these specific climatic variables may have to be used until an index of weather is computed." Another suggestion for wheat was "to combine such climatic influences as: June temperature, April-May precipitation, July temperature,

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1. Cromarty, W. A., The Economic Structure of Agriculture in the United States, A summary of work started in East Lansing, Mich., and carried on in Washington D. C. during the summer of 1954, mimeographed.

July precipitation, and September-October precipitation of the previous year into a weather index."

Going further back than Cromarty's study, the idea of using plot data to construct a weather index was used by G. L. Johnson in his study of burley tobacco control programs[1] and D. E. Hathaway in his study of the dry bean industry.[2]

The fact that indexes of the influence of weather were needed in Cromarty's study would probably be justification enough for this project. However, it is believed that an index of this type will be valuable when used for similar types of studies in the future or for general appraisal of the agricultural economy. This study should give an indication as to whether it is feasible to construct indexes of the scope computed in this study. Their use in particular studies will indicate whether or not they contribute to the study of the particular relationships being considered. There are, no doubt, other uses for such indexes which are not yet apparent.

Objectives

Considering the study from the standpoint of: (1) the interest and qualifications of the personnel, (2) the facilities available, (3) the budget, (4) the time available to

1. Johnson, G. L., Burley Tobacco Control Programs, Ky. A. E. S. Bul. 580, Feb., 1952.
2. Hathaway, D. E., The Effects of the Price Support Program on the Dry Bean Industry in Michigan, Mich. A.E.S. Tech. Bul. 250, Apr., 1955.

complete the study, (5) the appropriateness of the subject, and (6) the accuracy necessary and other considerations, the following more specific objectives were decided upon.

To construct indexes of the influence of weather on:

1. Yields of specific crops for the United States.
2. Important aggregate measures of U. S. agricultural production and yields.

It was believed that, considering the time and personnel available, it would be best to restrict this study to a few of the more important crops. The crops chosen to study were: corn, oats, barley, wheat, soybeans, cotton, and tobacco. Cotton and tobacco are important crops alone. Corn, oats, and barley are combined to give an indication of the influence of weather on feed grains. Wheat represents food grains, and soybeans represent oil crops. Thus, indexes are computed which give an indication of the influence of weather on some of the more important groups of crops. Even though not all crops in each group are included, the crops studied make up a large percentage of the group in each case. Table 8, page 86, gives an indication of the relative importance of the crops included in this study both individually and in total. It will be noted in the Index of Crop Production column that crops included in this study account for 63.6 percent of all crops. Several important crops, from a total value standpoint, have been left out as have many of lesser importance but which make up a large part of all crops when grouped together. Hay and forages are one important group of crops not accounted for directly although that group accounted for 11.54 percent of all crops in 1947-49.[1] Hay and forages were left out of this study partly because no way could be thought of to construct accurate indexes with the chosen method. A preliminary review of literature indicated that little plot data were available for constructing indexes by this method and that data available were mostly for alfalfa, which might not represent very well all hay and forages. Another reason for not computing the index for this important group of crops is the availability of indexes of range and pasture conditions published by the U.S.D.A. Vegetables, fruits and nuts, and sugar crops were also left out of this study although these are important groups of crops in total, and certain crops within these groups such as oranges and apples are important individually. Most crops left out were left out either because the method used to construct the weather indexes does not work well because of lack of appropriate data or because the crop is relatively unimportant from a total value standpoint.

Review of Literature

A review of literature was undertaken with two purposes in mind. One purpose was to review any literature dealing

1. See Table 19, U.S.D.A. Agriculture Handbook No. 118, Vol. 2, Agricultural Production and Efficiency.

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with studies of the same nature or studies which had something to contribute in the way of methodology and suggestions for this study. The other reason was to locate raw data to be used in this study.

No study was found which had the particular objectives or scope of this study. In the few studies found where an index of the influence of weather of the type to be constructed here was used, it was only for one crop or for a specific region. Most other studies found were interested in correlating rainfall or various components of weather with county, state, or United States average yields.

Johnson, in his study of burley tobacco control programs,[1] used an index of the influence of weather on burley tobacco constructed from plot data at various locations in the burley growing areas. Hathaway[2] used an index of the same type in his study of the dry bean industry in Michigan.

Studies which were mainly concerned with correlating various components of weather such as rainfall at various times, temperature, etc. with yields of crops and the year published included: a study of the relation between precipitation, temperature and yield of corn on the agronomy farm, Urbana, Illinois, by Runge, 1957;[3] a study of climatic factors and corn yields in Texas blacklands by Bates, 1954;[4] an analysis of

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1. Johnson, G. C., op. cit., p. 3.
2. Hathaway, D. E., op. cit., p. 3.
3. Runge, E. C. A., The Relation Between Precipitation, Temperature, and Yield of Corn on the Agronomy South Farm, Urbana, Illinois, Unpublished M.S. Thesis, Agronomy Dept., U. of Illinois, 1957.
4. Bates, R. P., "Climatic Factors and Corn Yields in Texas Blacklands," Agron. Abs., 46:85, 1954.

factors influencing cotton yields and their variability by Fulmer and Botts, 1951;[1] a study of range forage conditions in relation to annual precipitation by Clawson, 1948;[2] a study of the comparative effects of season, location and variety on the yield and quality of North Dakota hard red spring wheat by Harris, et. al., 1947;[3] a study of the techniques for measuring joint relationships of temperature and precipitation on corn yields by Hendricks and Scholl, 1943;[4] a study of climatological measurements for use in the prediction of maize yields by Bair, 1942;[5] a study of crop yields and weather by Bean, 1942;[6] a study of the relation of weather and its distribution to corn yields by Davis and Harrel, 1942;[7] a study of methods of computing a regression of yield on weather

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1. Fulmer, J. L. and R. R. Botts, Analysis of Factors Influencing Cotton Yields and Their Variability, U.S.D.A., Tech. Bul. 1042, Oct., 1951.

2. Clawson, M., "Range Forage Conditions in Relation to Annual Precipitation," Q. J. of Land Econ., Aug., 1948, pp. 264-280.

3. Harris, R. H., L. D. Sibbitt, L. R. Waldron, and T. E. Stoa, Comparative Effects of Seasons, Location, and Variety on the Yield and Quality of North Dakota Hard Red Spring Wheat, N. D. A.E.S. Bul. 342, Jan., 1947.

4. Hendricks, W. A. and J. C. Scholl, Techniques in Measuring Joint Relationships: The Joint Effects of Temperature and Precipitation on Corn Yields, N. C. A.E.S. Tech. Bul. 74, Apr., 1943.

5. Bair, R. A., "Climatological Measurements for Use in the Prediction of Maize Yield," Ecology, 23:79-88, 1942.

6. Bean, L., Crop Yields and Weather, U.S.D.A. Misc. Pub. 471, 1942.

7. Davis, F. E. and G. D. Harrell, Relation of Weather and Its Distribution to Corn Yields, U.S.D.A. Tech. Bul. 806, Feb., 1942.

by Houseman, 1942;[1] a study of the influence of distribution of rainfall and temperature on corn yields in western Iowa by Houseman and Davis, 1942;[2] a study of the effect of the amount and distribution of rainfall and evaporation during the growing season on yields of corn and spring wheat by Davis and Palleson, 1940;[3] a study of weather influences on crop yields by Visher, 1940;[4] a study of growth and yield in wheat, oats, flax, and corn as related to environment by Dunhan, 1938;[5] a study of the influence of rainfall on the yield of cereals in relation to manurial treatment by Cochran, 1935;[6] a study of the relation between crop yields and precipitation in the great plains area by Chilcott, 1931;[7] a study of forecasting wheat yields from the weather by Alsberg and Griffing, 1928;[8] a study of the relationship of weather to crops in the

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1. Houseman, E. E., Methods of Computing a Regression of Yield on Weather, Iowa A.E.S. Res. Bul. 302, June, 1942.

2. Houseman, E. E. and F. E. Davis, "Influence of Distribution of Rainfall and Temperature on Corn Yields in Western Iowa," Jour. Agr. Res., 65:533-545, 1942.

3. Davis, F. E. and J. E. Palleson, "Effect of the Amount and Distribution of Rainfall and Evaporation During the Growing Season on Yields of Corn and Spring Wheat," Journ. Agr. Res., 60:1-23, illus., Jan., 1940.

4. Visher, S. S., "Weather Influences on Crop Yields," Econ. Geog., 16:437-443, 1940.

5. Dunham, R. S., "Growth and Yield in Wheat, Oats, Flax, and Corn as Related to Environment," Amer. Soc. Agron. Journ., 30:895-908, 1938.

6. Cochran, W. G., "A Note on the Influence of Rainfall on the Yield of Cereals in Relation to Manurial Treatment," J. Agr. Science, 25:510-522, 1935.

7. Chilcott, E. C., The Relation Between Crop Yields and Precipitation in the Great Plains Area, U.S.D.A. Misc. Cir. 81, 1931.

8. Alsberg, C. L. and E. P. Griffing, "Forecasting Wheat Yields from the Weather, 1928," Stanford Univ. Food Research Institute, Wheat Studies, 5:1-44.

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plains region of Montana by Patton, 1927;[1] a study of the effect of climatic conditions on the growth of barley by Gregory, 1926;[2] a study of coefficients of correlation between May and June rainfall and the yield of wheat from 1911 to 1926 by Willard;[3] a study of the influence of rainfall on the yield of wheat at Rothamsted, England, by Fisher, 1924;[4] a study of forecasting crops from the weather by Brooks, 1922;[5] a mathematical inquiry into the effect of weather on corn yields in eight corn belt states by Wallace, 1920;[6] a study of the relation of moisture to yield of winter wheat in western Kansas by Call and Hallsted, 1915;[7] and a study of the relationship of precipitation to yield of corn by Smith, 1903.[8]

Though the above is certainly not an exhaustive list of all the studies concerned with the influence of weather on crops, it covers a good proportion of them from which cross

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1. Patton, P., Relationship of Weather to Crops in the Plains Region of Montana, Mont. A.E.S. Bul. 206, 1927.
2. Gregory, F. G., "The Effect of Climatic Conditions on the Growth of Barley," Am. Bot., 40:1-26, 1926.
3. Willard, R. E., Coefficients of Correlation Between May and June Rainfall and the Yield of Wheat from 1911 to 1926, N. D. A.E.S. Bul. 212, July, 1927.
4. Fisher, R. A., "The Influence of Rainfall on the Yield of Wheat at Rothamsted," Roy. Soc. (London) Phil. Trans. Ser. B, 213:89-142, illus., 1924.
5. Brooks, C. F., "Forecasting the Crops from the Weather, 1922," Geog. Rev., 12:305-307.
6. Wallace, H. A., "Mathematical Inquiry Into the Effect of Weather on Corn Yield in the Eight Corn Belt States," U.S. Mo. Weather Rev., 48:439-446, Aug., 1920.
7. Call, L. E. and A. L. Hallsted, The Relation of Moisture to Yield of Winter Wheat in Western Kansas, Kan. A.E.S. Bul. 206, 1915.
8. Smith, J. W., "Relation of Precipitation to Yield of Corn," U.S.D.A. Yearbook, 1903, 215-224.

references to other studies can be found. Although much work appears to have been done on the influence of weather on crops, no study was found which actually provided indexes of the total influence of weather for the major crops and for the whole United States in a form that could be used in econometric models such as Cromarty's. Cromarty did use various measures of weather in his system of equations such as rainfall, unharvested acres and others but expressed the conviction that these might be improved upon.[1]

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1. Cromarty, *op. cit.*, p. 2.

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CHAPTER II

CONCEPTUAL FRAMEWORK AND MEASUREMENT TECHNIQUES

General Conceptual Framework Used

The conceptual framework for measuring the influence of weather on crops in this study is similar to that used by Johnson[1] and Hathaway[2] and discussed by Cromarty.[3] It is hypothesized that if time series of yields for the studied crops can be obtained from experimental plots in the areas where the particular crops are grown and where as many variables as possible have been held constant, the remaining variation in yield from year to year should give an indication of the influence of "weather" after trend has been removed to account for increases or decreases in fertility level in the soil.

Actually, only part of the variation in plot yields can be explained by direct weather influences, even after trend has been removed to account for increases and decreases in soil fertility. The part not due directly to weather influences can be further classified as variation which is correlated with weather influences and variation not correlated with weather influences. Examples of factors causing variation in yields which may be correlated with weather influences

1. Johnson, G. L., op. cit., p. 3.
2. Hathaway, D. E., op. cit., p. 3.
3. Cromarty, W. A., op. cit., p. 2.

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include such things as insect damage, plant disease, and soil moisture levels. Examples of factors causing variation in yields which may not be correlated with weather influences include such things as uncontrolable variations in seed and fertilizer application, cultural practices, crop damage by various pests, various accidental occurrances and other factors which cannot be accounted for. All direct and indirect influences of weather will be called the influence of "weather" in this study. It will be assumed that all variations in plot yield due to non-weather factors not correlated with weather are randomly and normally distributed with an expected value of zero. It will be further assumed that the trend due to fertility increases or decreases is linear and can be removed by the standard statistical method of fitting a regression line of yield on time and measuring deviations about the computed yield for each year. Indexes can be computed for specific crops at particular locations by dividing the actual by the computed yield each year. Indexes at each location can then be weighted together using production figures for the area represented by each location into an index for the whole United States for each crop. Indexes for various aggregate measures can then be constructed by weighting indexes for each crop contained therein by the value of production of each.

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Techniques Used in This Study

Some Preliminary Considerations

Choosing the General Approach

Various alternatives for constructing indexes of the influence of weather on crop yields were considered. The technique used by Johnson and Hathaway, as discussed in Chapter I, was decided upon. One method considered was to use some of the measures Cromarty used such as rainfall and unharvested acreage. Another method considered was to combine various components of weather into an index in some manner. There are some important difficulties in using rainfall, however. These include the fact that annual rainfall alone is frequently not the only important determinant of yield; the time when rainfall occurs is also important. Another difficulty is that rainfall alone is not the only component of weather affecting yield. Other components of the weather such as wind, sunlight, temperature, relative humidity, level of the water table affected by prolonged drouth and possibly other factors enter into the total effect of weather. A review of the literature mentioned earlier revealed that construction of a model to measure the various components of weather would be difficult and expensive to work with empirically since the interrelationships between the various components are very complicated. Although there appeared to be several studies on the influence of various components of weathe

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weather on various crops, the results were, in general, incomplete in that usually no more than one or two components were considered at a time and these were usually for a specific crop in a specific location.

The main objections to using unharvested acreage and/or yields attained by farmers as an indication of the influence of weather on particular crops would appear to be that they are related to each other and that important non-random variables other than weather influence unharvested acreage and yield. A rather important variable in some years and for some crops would be price. In some years prices are low enough to discourage fertilization and good cropping practices in addition to encouraging abandonment of a crop. In other years, high prices stimulate use of yield increasing practices and harvesting of poor acreages. This is verified empirically for burley tobacco by Johnson in his study of burley tobacco control programs.[1] It is desirable to leave such influences out of an index of the influence of weather as it is the interest of economists to analyze these separately.

After the advantages and disadvantages of various alternatives were considered, it was decided to use the experimental plot method. The main consideration for using this method was that it was felt that, from a theoretical standpoint, it should measure what it was desired to measure.

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1. Johnson, G. L., op. cit., p. 3.

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Another important consideration was that this general technique had been used with apparent success by Johnson and Hathaway.

Deciding upon the crops to include.

Crops selected for this study were corn, oats, barley, wheat, soybeans, cotton, and tobacco. The selection of these particular crops was based on such criteria as relative importance from a total value standpoint of each crop both individually and within important groups of crops, the time and resources available and availability of data. It has already been mentioned in Chapter I why no attempt was made to compute indexes for hay, forage, or silage. For one reason it was felt that appropriate data of the type needed could not be obtained and, on the other hand, a substitute which could be used for such an index was already available as indexes of pasture and range condition published in various U.S.D.A. publications. For some irrigated crops it was felt that no index of the influence of weather was needed since weather would cause little variation in the yields of these crops. Also, most individual irrigated crops do not make up a very high percentage of the total value of crop production in the United States.

Roughly, the most important criterion for selection of individual crops was to select those which made up five percent or more of the total value of all crops produced in the United States over a recent time period except in the case of hay and forage crops, soybeans and barley. Barley was chosen because the data were readily available and the barley index would contribute to the computation of the feed grain index. Soybeans were chosen because some measure of the influence of weather on oil crops was desired and soybeans was the most important oil crop. (See Table 8, page 86). Some fruits were relatively important (individually) from a total value standpoint such as citrus fruits and apples, but the proposed method of constructing the indexes would be difficult to use on these because of the nature of their production.

<u>Deciding Upon the Time Period</u>

The time period for this study was chosen considering availability of data and possible uses of the indexes. A review of the available data suggested that it would be difficult to construct an index further back than 1900 and that, even with this rather recent starting point, data would be scarce until approximately 1930. Also, most econometric studies using historical data do not go back further than 1930. It was decided, however, to construct the various indexes back to 1900 and present them along with their limitations.

Procurement of Data

The first step was to decide where in the United States plot data were needed. These decisions were based on concentration of production of the crop under consideration, the need for homogeneous areas with respect to weather and geographic characteristics and the availability of data. In many cases, it became a matter of deciding where data could be obtained and then deciding whether or not they were adequate for the purpose for which they were to be used. A large part of the time spent reviewing literature was spent searching for experimental plot data already published. It soon became apparent, however, that an adequate amount of data could not be obtained from published sources. To supplement published material, it was decided to write to the various agronomy departments where data were needed. Directors of the various experiment stations were contacted in order to explain the project and to facilitate cooperation and understanding in obtaining data from their respective agronomy departments. A letter was then sent to the heads of the various agronomy departments asking for the data needed. The responses to these letters were, in most cases, rapid and fruitful. However, in many important locations it was indicated that data would be difficult to obtain without additional personnel and reimbursement, the chief reason in most cases being that the data were not in the form needed and that a considerable amount of work would be required to obtain it from the records. In some cases budget limitations for this project made data of the type needed simply not available for this study. Funds were not available to obtain data that could not be obtained either in published form or through correspondence by letter or by telephone.

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In order to do a more thorough job on a project of this sort, more time, personnel, and money would be needed to aid in obtaining data from certain areas where it is desired and where it is more difficult to obtain. If there is a demand for more accuracy than is afforded by the indexes in this study, or if it is desired to keep these up to date, a more comprehensive project should be undertaken, possibly by the United States Department of Agriculture.

Treatment of Data

As data were obtained from various sources, each separate series was copied onto a form especially designed for the purposes of removing the trend and computing the index. (See form in Appendix B). The general technique for computation of the various indexes in order of their computation is outlined as follows:

1. Indexes for each series, each crop at each location: These were computed directly on the form mentioned above.
2. Indexes for each crop at each location: The indexes for each series were averaged together into an index for each crop at each location. This involved much subjective screening of data, consideration of whether or not there were weather cycles, splicing shorter series together and other difficulties. Construction of these indexes involved making various rules to follow

and assumptions as difficulties arose. Some of these were as follows:

a. If series were no longer than five years, trend was not removed. Deviations from the average were used instead. Such series were used only when longer series could not be found for the particular purpose.

b. If weather cycles appeared to exist when detected by computing moving averages at various locations, the beginning and ending points for each series were chosen so as to connect similar stages of the cycle or, in general, avoid short run trends due to cycles which did not reflect the longer run trend of increases or decreases in soil fertility.

c. Indexes for each year at each location were checked against each other, against county, state, or U. S. average yields and against various other measures such as unharvested acreage, rainfall, etc. which would reflect the influence of weather on yield to some extent. When individual figures looked irregular by comparison, the original source of data was rechecked for mistakes or for various disturbances at each location which might have caused the suspected irregularity. Many such irregularities were eliminated from the data by this method.

3. Indexes for each crop for the whole United States: These were computed by taking the indexes for each crop at each location and weighting them into a series for the whole United States using average production in the area represented by each location during a recent period as weights. See Tables 1, 2, 3, 4, 5, 6, and 7, Chapter 3, for computations of weights and indexes for each crop.

4. Indexes for important aggregate measures of U. S. agricultural production and yields: These measures include important series currently published and maintained by the United States Department of Agriculture. In this study an index of the influence of weather was computed for four production measures including the Index of Crop Production, the Index of Gross Farm Production, the Index of Farm Output, and the Index of Farm Marketings and Home Consumption. An index of the influence of weather on the Index of Crop Yields Per Harvested Acre was also computed. In addition, indexes of the influence of weather on the feed grain components of the Index of Crop Production, the Index of Farm Output, and the Index of Farm Marketings and Home Consumption were computed.

In computing these indexes, indexes for the separate crops for the United States were weighted together according to their relative dollar value of production during 1947-49 as presented in Tables 19, 27, 31, and 34 in U.S.D.A. Agriculture Handbook No. 118.[1] A more detailed description of the various measures and the methods used are presented in Chapter IV.

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1. U.S.D.A. Agriculture Handbook No. 118, *op. cit.*, p. 5.

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CHAPTER III

INDEXES OF THE INFLUENCE OF WEATHER ON SPECIFIC CROPS

This chapter explains the computation of the indexes of the influence of weather on individual crops including corn, oats, barley, wheat, soybeans, cotton, and tobacco. An evaluation of all indexes is presented in Chapter V.

In computing these indexes, trend was removed from each separate series of raw yields at each location by estimating the parameters of a linear regression equation of yield on time except in the case of very short series of five years or less. Indexes were then computed as the ratio of the actual to the computed yields in each year. In the case of the shorter series, indexes were computed as the ratio of the actual yield to the mean. However, these shorter series were only used when no other data were available for the particular years. These separate indexes of varying lengths were then combined at each location into one index. This involved averaging the overlapping years of each separate index. The indexes for each location were then weighted together into an index for the whole U. S. according to production represented by the index at each location. Further detail as to the computation of each index is discussed in the following sections of this chapter pertaining to each crop.

In computing the weights for each location, homogeneous areas with respect to weather characteristics were mainly arrived at by considering maps and data presented in Climate and Man.[1] Similar characteristics with respect to rainfall, growing season, and other relevent factors were considered.

Corn

Corn is the most important feed grain as well as the most important crop, from a total value standpoint, grown in the United States. It accounted for about seventy-five percent of the value of all feed grains and for nearly a fourth of the total value of crop production in 1947-49 (See Table 8, page 86). Figure 1 gives an indication of the location of corn production. Important areas of corn production are indicated as well as the average percentage production by states for 1946-55.

An attempt was made to obtain time series plot data for constructing the index from states having approximately five percent or more of the total corn production and from locations representing the highest concentration of production. Usable data were obtained from Urbana, Illinois; Ames, Iowa; Columbia, Missouri; Lincoln, Nebraska; North Platte, Nebraska; and Wooster, Ohio. Gaps include data from Minnesota, Wisconsin, and Indiana; but these were not considered serious enough

1. U.S.D.A., Climate and Man, Yearbook of Agriculture, 1941.

Figure

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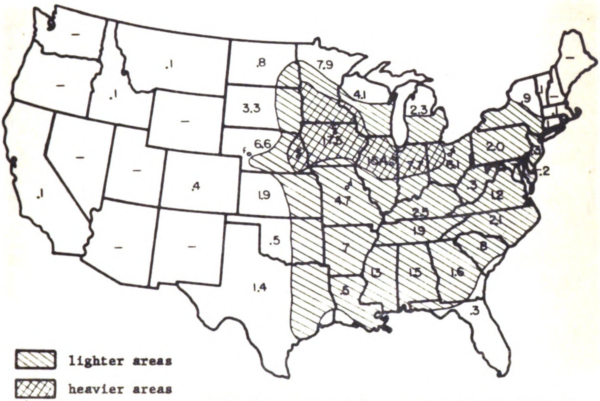
Figure 1: Location of Corn Production and Average Percentage of Total Production by States, 1946-55.a/



lighter areas

heavier areas

a/ Average percentage production computed from production for 1946-55 reported in Crop Production, USDA, AMS, Nov. 12, 1957. General boundaries of greatest corn production derived from Van Royen, W., Agricultural Resources of the World, Prentice-Hall, 1954, Vol. 1.

b/ Urbana, Ill.

c/ Ames, Iowa

d/ Columbia, Mo.

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to warrant expending extra time and money in further attempts to obtain data from these states. Chief difficulties in obtaining data from these locations were: data were in a form which made time series difficult to extract, or time and personnel were not available to obtain such data, or there were no adequate data available.

In constructing the index of the influence of weather on corn, weights were computed by determining the area to be represented by each location and computing the percent of total production represented by that area. Although it was recognized that, ideally, areas of production to be represented by each location would not necessarily follow state boundaries, it was felt that in the case of corn the possible added accuracy which might be obtained by divisions smaller than state boundaries was not worth the extra time and inconvenience. This is in accord with one criterion of the scientific method which states that "there is no point in sharpening precision to a higher degree than the problem at hand requires. (You need no razor to cut butter.)"[1]

Considering the areas of production and the weather characteristics of the various areas, the areas to be represented by each location were decided upon. The computation of the index for the whole United States including computed indexes at each location and weights is presented in Table 1. A comparison of the index with United States average yields is presented in Figure 2.

1. Feigl, H., "The Scientific Outlook: Naturalism and Humanism," Readings in the Philosophy of Science, Appleton-Century-Crofts, p. 12.

TABLE 1 -- COMPUTATION OF THE INDEX OF THE INFLUENCE OF WEATHER ON CORN[a]

Lincoln, Neb. N. Platte, Neb. Wooster, Ohio Computed

TABLE 1 -- COMPUTATION OF THE INDEX OF THE INFLUENCE OF WEATHER ON CORN[a]

	Urbana, Ill.		Ames, Iowa		Columbia, Mo.		Lincoln, Neb.		N. Platte, Neb.		Wooster, Ohio		Computed
Year	Index	Weight	Index	Weight	Index	Weight	Index	Weight	Index	Weight	Index	Weight	Index
1900					80.1	1.00[b]							80.1
1901					31.8	1.00							31.8
1902					224.7	.55[c]	129.0	.45[c]					181.6
1903	73.4	.57[d]			157.9	.22[d]	130.7	.21[d]					104.0
1904	86.4	.57			38.3	.22	109.5	.21					80.7
1905	109.1	.57			184.6	.22	128.9	.21					129.9
1906	100.7	.77[e]			---	---	119.7	.23[e]					105.1
1907	118.4	.57[f]			97.1	.22[f]	121.4	.16[f]	113.6	.05[f]			114.0
1908	88.9	.57			34.2	.22	102.6	.16	143.7	.05			81.8
1909	110.0	.57			48.8	.22	77.5	.16	146.2	.05			93.1
1910	140.1	.57			19.2	.22	116.3	.16	29.1	.05			104.1
1911	75.3	.57			74.6	.22	87.3	.16	3.3	.05			73.5
1912	147.4	.57			92.1	.22	98.7	.16	138.1	.05			127.0
1913	80.0	.57			57.7	.22	16.7	.16	0.0	.05			61.0
1914	93.6	.57			102.5	.22	111.8	.16	25.1	.05			95.0
1915	128.1	.45[g]			138.9	.20[g]	160.3	.16[g]	127.1	.05[g]	103.1	.14[g]	131.9
1916	57.0	.45			44.6	.20	134.3	.16	51.0	.05	84.1	.14	70.4
1917	137.1	.45			109.5	.20	103.2	.16	46.9	.05	102.9	.14	116.9
1918	95.7	.45			69.3	.20	6.7	.16	114.0	.05	76.7	.14	74.4
1919	96.9	.23[h]	108.2	.30[h]	121.6	.20[h]	47.4	.08[h]	175.5	.05[h]	131.5	.14[h]	110.0
1920	126.0	.23	116.0	.30	158.9	.20	123.6	.08	195.2	.05	92.4	.14	128.1
1921	107.7	.23	100.6	.30	134.7	.20	136.9	.08	101.9	.05	95.2	.14	111.3
1922	92.7	.23	103.6	.30	142.5	.20	105.3	.08	160.7	.05	93.6	.14	110.5
1923	96.3	.23	102.1	.30	135.7	.20	135.1	.08	252.2	.05	94.9	.14	116.6
1924	85.0	.23	78.1	.30	121.1	.20	87.2	.08	108.3	.05	110.6	.14	95.1

Table 1--Continued.

Lincoln, Neb.	N. Platte, Neb.	Wooster, Ohio	Computed

Table 1--Continued.

Year	Urbana, Ill. Index	Urbana, Ill. Weight	Ames, Iowa Index	Ames, Iowa Weight	Columbia, Mo. Index	Columbia, Mo. Weight	Lincoln, Neb. Index	Lincoln, Neb. Weight	N. Platte, Neb. Index	N. Platte, Neb. Weight	Wooster, Ohio Index	Wooster, Ohio Weight	Computed Index
1925	101.5	.23	109.1	.30	109.6	.20	93.7	.08	41.5	.05	156.4	.14	109.5
1926	98.3	.23	76.3	.30	64.2	.20	46.3	.08	9.8	.05	113.2	.14	78.4
1927	120.5	.23	84.0	.30	78.9	.20	161.3	.08	230.3	.05	105.9	.14	107.9
1928	82.2	.23	100.5	.30	116.8	.20	112.0	.08	158.6	.05	141.5	.14	109.1
1929	93.3	.23	97.6	.30	25.7	.20	146.6	.08	67.7	.05	115.7	.14	87.2
1930	64.4	.23	76.7	.30	13.3	.20	28.9	.08	141.3	.05	31.4	.14	54.3
1931	96.7	.23	103.0	.30	167.2	.20	94.5	.08	66.8	.05	92.6	.14	110.4
1932	106.4	.23	106.5	.30	128.9	.20	180.9	.08	35.3	.05	82.5	.14	110.0
1933	51.5	.23	101.6	.30	109.7	.20	106.9	.08	112.3	.05	73.9	.14	88.8
1934	95.3	.41[i]	52.9	.30[i]	---	---	0.0	.10[i]	0.0	.05[i]	109.3	.14[i]	70.2
1935	119.7	.23[j]	132.7	.30[j]	61.0	.20[j]	54.1	.13[j]	---	---	129.0	.14[j]	104.6
1936	36.7	.41[k]	59.1	.30[k]	---	---	0.0	.10[k]	111.8	.05[k]	99.1	.14[k]	52.2
1937	125.6	.23[l]	155.3	.30[l]	148.3	.20[l]	15.7	.13[l]	---	---	99.0	.14[l]	121.0
1938	127.0	.23[m]	103.2	.30[m]	156.7	.20[m]	12.8	.08[m]	83.8	.05[m]	110.2	.14[m]	112.2
1939	107.0	.41[n]	127.8	.30[n]			13.1	.10[n]	47.0	.05[n]	88.9	.14[n]	98.3
1940	72.4	.41[o]	108.9	.30[o]			60.6	.15[o]	---	---	91.6	.14[o]	84.3
1941	117.7	.41[p]	123.7	.30[p]			44.9	.10[p]	197.3	.05[p]	101.3	.14[p]	113.9
1942	110.8	.41	122.7	.30			91.3	.10	39.5	.05	91.4	.14	106.1
1943	90.6	.41	111.0	.30			121.0	.10	167.0	.05	105.3	.14	105.6
1944	98.1	.41	98.0	.30			135.6	.10	177.0	.05	40.7	.14	97.7
1945	103.5	.41	98.9	.30			110.8	.10	145.0	.05	78.4	.14	101.4
1946	115.2	.41	100.4	.30			127.7	.10	82.3	.05	71.3	.14	104.2
1947	72.7	.41	54.3	.30			44.9	.10	107.2	.05	79.6	.14	67.1
1948	127.2	.41	124.5	.30			140.2	.10	98.1	.05	87.9	.14	120.7
1949	106.2	.41	87.7	.30			95.8	.10	119.7	.05	129.6	.14	103.6

Table 1--Continued.

Year	Urbana, Ill. Index	Urbana, Ill. Weight	Ames, Iowa Index	Ames, Iowa Weight	Columbia, Mo. Index	Columbia, Mo. Weight	Lincoln, Neb. Index	Lincoln, Neb. Weight	N. Platte, Neb. Index	N. Platte, Neb. Weight	Wooster, Ohio Index	Wooster, Ohio Weight	Computed Index
1950	98.2	.41	105.3	.30			140.0	.10	101.5	.05	114.2	.14	106.9
1951	106.9	.41	69.7	.30			78.5	.10	116.7	.05	123.8	.14	95.8
1952	92.8	.71[q]							89.5	.15[q]	154.2	.14[q]	100.9
1953	92.4	.71							31.6	.15	97.1	.14	83.9
1954	103.9	.85[r]							110.0	.15[r]			104.8
1955	110.4	1.00[s]											110.4
1956	119.4	1.00											119.4

a. Indexes at each location were computed using the procedure indicated in Chapter II. Raw data used are presented in Appendix A.

b. 1900-01: Columbia, Mo., weight includes all production.

c. 1902: Columbia, Mo., weight includes production from Mo., Ill., Ind., Ohio, N. Y., Vt., Mass., Conn., N. J., Del., Md., Penn., Va., W. Va., Ky., Tenn., Okl., Texas, Ark., La., Ala., Miss., Ga., Fla., N. C., and S. C. Lincoln, Neb., weight includes production from Neb., Kan., Col., Iowa, N. D., S. D., Minn., Wisc., Mich., Mont., Idaho, and Calif.

d. 1903-05: Urbana, Ill., weight includes production from Ill., Ind., Ohio. Mich, Pa., N. Y., N. J., Conn., Mass., Vt., Wisc. and Iowa. Columbia, Mo., weight includes production from Mo., Okl., Texas, Ark., La., Miss., Ala., Ky., Tenn., Ga., Fla., S. C., N. C., Va., W. Va., Md., and Del. Lincoln, Neb., weight includes production from Neb., N. D., S. D., Mont., Idaho., Calif., Kan., Col., and Minn.

e. 1906: Urbana, Ill. weight includes production from Ill., Ind., Ohio, Wisc., Iowa, Mo., Ark, La., Miss., Ala., Ky., Tenn., Mich., Ga., Fla., N. C., S. C., Va., W. Va., Pa., Md., N. J., Conn., Mass., Vt., and N. Y. Lincoln, Neb., weight includes production from Neb., N. D., S. D., Kan., Okl., Texas, Col., Mont., Idaho, Calif., and Minn.

f. 1907-14: Urbana, Ill., and Columbia, Mo., weights same as for 1903-5 (See d). Lincoln, Neb., weight includes production from 3/4 of Neb., 1/2 of S. D., Minn., and Kan. N. Platte, Neb., weight includes production from 1/4 of Neb., 1/2 of S. D., N. D., Col., Mont., Idaho, and Calif.

g. 1915-18: Urbana, Ill., weight includes production from Ill., Ind., Wisc., and Iowa. Columbia, Mo., weight includes production from Mo., Okl., Texas, Ark., La., Miss., Ala., Fla., Ga., Ky., Tenn., N. C. and S. C. Lincoln, Neb., and N. Platte, Neb., are the same weights as for 1907-14 (See f). Wooster, Ohio, weight includes production from Ohio, Mich., Pa., N. Y., Vt., Mass., Conn. N. J., Md., Del., Va., and W. Va.

Table 1--footnotes--continued.

h. 1919-33: Urbana, Ill., weight includes production from Ill. and Ind. Ames, Iowa, weight includes production for Iowa, Minn., and Wisc. Columbia, Mo., weight is the same as 1915-18 (See g). Lincoln, Neb., weight includes production from 3/4 of Neb., 1/2 of S. D., and Kan., N. Platte, Neb., and Wooster, Ohio, weights are the same as 1915-18 (See g).

i. 1934: Urbana, Ill., weight includes production from Ill., Ind., Mo., Ark., La., Ky., Tenn., Miss., Ala., Ga., Fla., S. D. and N. C. Ames, Iowa, weight is the same as 1919-33 (See h). Lincoln, Neb., weight includes production from 3/4 of Neb., 1/2 of S. D., Kan., Okl., and Texas. N. Platte, Neb., and Wooster, Ohio, weights are the same as for 1915-18 (See g).

j. 1935: Urbana, Ill., Ames, Iowa, Columbia, Mo., and Wooster, Ohio, weights are the same as for 1919-33 (See h). Lincoln, Neb., weight now contains the combined weights of Lincoln, Neb., and N. Platte, Neb., for 1919-33.

k. 1936: All weights are the same as for 1934 (See i).

l. 1937: All weights are the same as for 1935 (See j).

m. 1938: All weights are the same as for 1919-33 (See h).

n. 1939: All weights are the same as for 1934 (See i).

o. 1940: All weights are the same as for 1934 (See i) except that Lincoln, Neb., weight now includes N. Platte, Neb., weight.

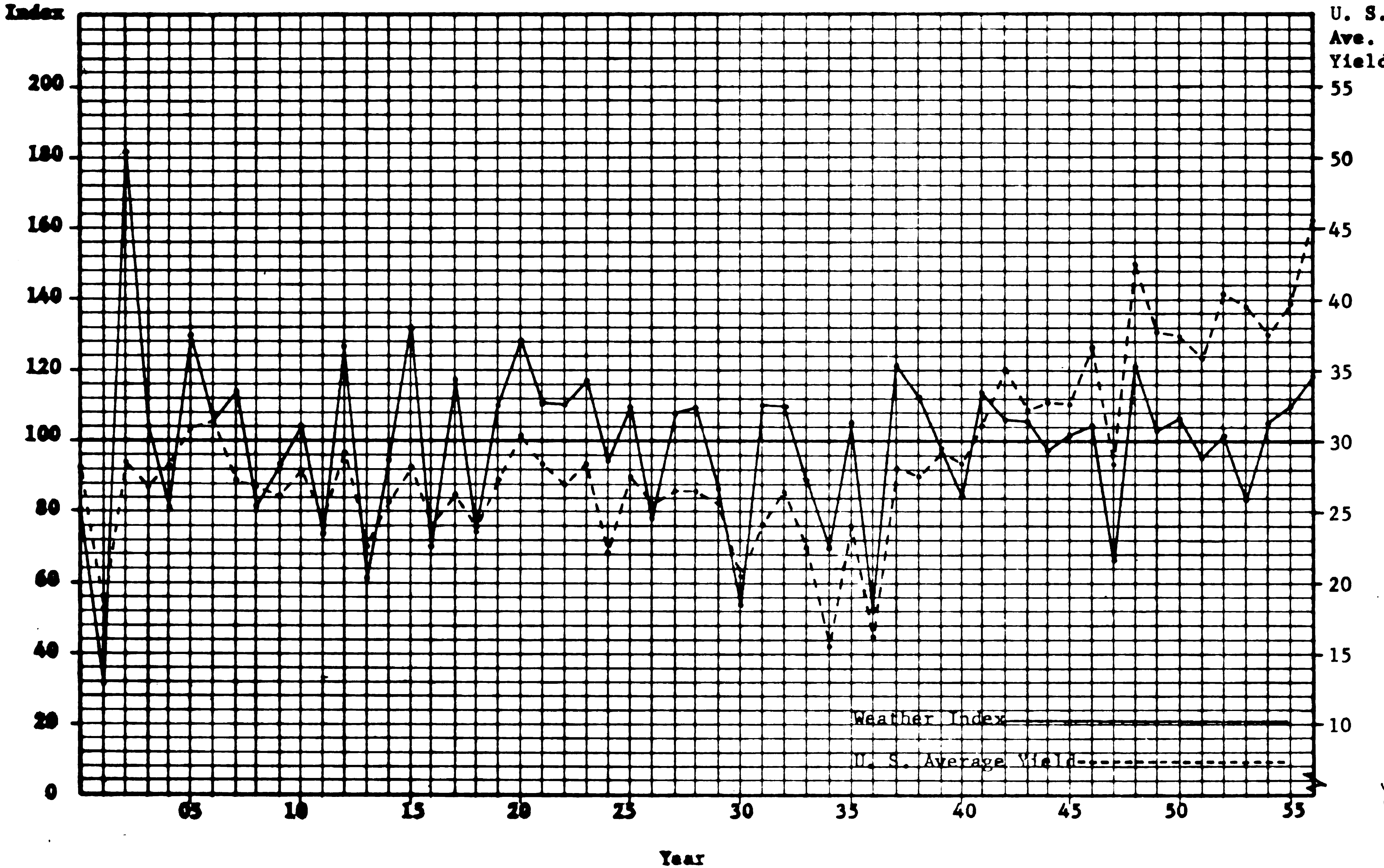
p. 1941-51: All weights are the same as for 1934 (See i).

q. 1952-53: Urbana, Ill., weight includes production from Ill., Minn., Iowa, Mo., Ark., La., Wisc., Ind., Ky., Tenn., Miss., Ala., Fla., Ga., S. C., and N. C. N. Platte, Neb., weight includes production from Neb., N. D., S. D., Kan., Okl., Texas, Col., Mont., Idaho, and Calif. Wooster, Ohio weight is the same as for 1915-18 (See g).

r. 1954: Urbana, Ill., weight same as for 1952-53 (See q) except weight for Wooster, Ohio, for 1952-53 is now included in the Urbana, Ill., weight. Weight for N. Platte, Neb., is the same as for 1952-53.

s. 1955-56: Urbana, Ill., weight includes all production.

Figure 2: Comparison of the Index of the Influence of Weather on Corn with U. S. Average Yield of Corn.

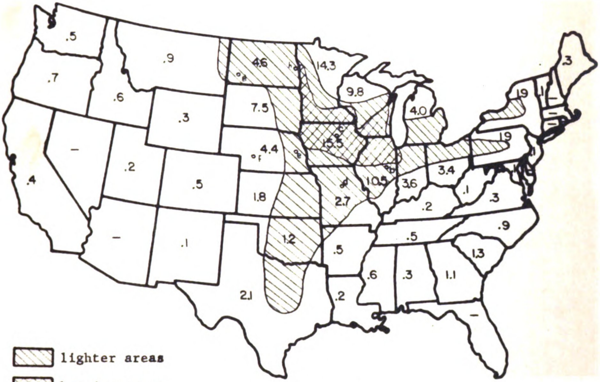


Oats

Oats is an important single crop from a total value standpoint in the United States. It is the second most important feed grain accounting for 16.7 percent of the total value of that group and accounting for 5.26 percent of the total value of all crops produced in 1947-49 (See Table 8, page 86). Oats production is centered in the North Central United States. Some production exists in almost every state but the bulk of the production is concentrated in Iowa, southern Minnesota, southern Wisconsin, and northern Illinois (See Figure 3). These four states account for approximately 50 percent of the oats production. Over 80 percent of the oats production is accounted for if some of the states surrounding these four states are added including North Dakota, South Dakota, Nebraska, Missouri, Indiana, Michigan, and Ohio.

Oats data were desired from Iowa, Minnesota, Wisconsin, and Illinois as well as for some of the surrounding states mentioned above. Usable data were obtained from Urbana, Illinois; Ames, Iowa; Columbia, Missouri; Lincoln, Nebraska; North Platte, Nebraska; Dickinson, North Dakota; and Fargo, North Dakota. Important gaps in the data from Minnesota and Wisconsin were not considered serious enough to warrant further effort at this time.

Figure 3: Location of Oats Production and Average Percentage of Total Production by States, 1944-53.a/



lighter areas

heavier areas

a/ Average percentage production computed from production for 1944-53 reported in Crops and Markets, USDA, AMS, 1956 edition, Vol. 33. General boundaries of greatest production derived from Van Royen, W., Agricultural Resources of the World, Prentice-Hall, 1954, Vol. 1.

b/ Urbana, Ill.

c/ Ames, Iowa

d/ Columbia, Mo.

e/ Lincoln, Neb.

f/ N. Platte, Neb.

g/ Dickinson, N. D.

h/ Fargo, N. D.

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The constructed index along with the indexes at each location and weights are presented in Table 2. A comparison of the index with United States average yields is presented in Figure 4.

TABLE 2: COMPUTATION OF THE INDEX OF THE INFLUENCE OF WEATHER ON OATS[a]

Year	Urbana, Ill. Index	Urbana, Ill. Weight	Ames, Iowa Index	Ames, Iowa Weight	Columbia, Mo. Index	Columbia, Mo. Weight	Lincoln, Neb. Index	Lincoln, Neb. Weight
1900					199.0	1.00[b]		
1901					8.2	1.00		
1902					105.4	1.00		
1903					---	---		
1904	49.2	.40[c]			84.4	.60[c]		
1905	115.6	.40[d]			59.8	.34[d]	191.8	.26[d]
1906	113.9	.40			117.4	.34	92.8	.26
1907	68.3	.40[e]			135.8	.19[e]	104.5	.26[e]
1908	56.1	.40			82.2	.19	134.9	.26
1909	83.1	.40			63.8	.19	158.9	.26
1910	108.3	.40			76.2	.19	111.3	.26
1911	135.5	.40			57.2	.19	84.2	.26
1912	150.6	.40			134.6	.19	77.9	.26
1913	52.4	.40			25.9	.19	114.7	.26
1914	96.9	.40[f]			19.2	.12[f]	148.1	.15[f]
1915	153.6	.35[g]	74.8	.31[g]	135.3	.04[g]	108.8	.07[g]
1916	122.4	.35	94.4	.31	120.2	.04	119.4	.07
1917	116.7	.35	124.1	.31	231.8	.04	201.0	.07
1918	116.0	.35	81.6	.31	101.6	.04	19.5	.07
1919	69.6	.35	86.7	.31	99.4	.04	82.4	.07
1920	75.7	.35	129.0	.31	101.4	.04	131.0	.07
1921	72.7	.35	97.0	.31	163.0	.04	112.6	.07
1922	91.4	.35	98.0	.31	57.8	.04	73.6	.07
1923	108.5	.35	109.1	.31	133.4	.04	147.8	.07
1924	130.9	.35	123.3	.31	115.5	.04	100.4	.07
1925	80.5	.35	69.1	.31	122.6	.04	57.8	.07
1926	141.5	.35	81.1	.31	126.2	.04	61.0	.07
1927	112.6	.35	93.4	.31	133.8	.04	119.0	.07
1928	112.2	.35	93.8	.31	151.8	.04	105.1	.07
1929	121.5	.35	121.8	.31	91.4	.04	137.6	.07
1930	106.2	.35	100.7	.31	67.6	.04	130.2	.07
1931	107.7	.35	96.6	.31	129.6	.04	131.2	.07
1932	131.7	.35	129.1	.31	57.0	.04	109.6	.07
1933	76.9	.35	84.3	.31	96.4	.04	0.0	.07
1934	23.5	.35	39.4	.31	13.8	.04	0.0	.07
1935	115.2	.35[h]	124.0	.31[h]	99.9	.04[h]	96.4	.11[h]
1936	91.5	.35	101.3	.31	50.0	.04	32.3	.11
1937	122.7	.35[i]	166.6	.31[i]	166.1	.04[i]	96.1	.07[i]
1938	85.2	.35	81.2	.31	43.5	.04	105.4	.07
1939	72.9	.36[j]	82.6	.34[j]			60.1	.07[j]

Table--Continued.

Year	Urbana, Ill. Index	Weight	Ames, Iowa Index	Weight	Columbia, Mo. Index	Weight	Lincoln, Neb. Index	Weight
1940	131.5	.36	75.6	.34			26.1	.07
1941	95.2	.36	119.8	.34			92.5	.07
1942	80.2	.36	122.2	.34			121.0	.07
1943	85.9	.36	122.7	.34			161.2	.07
1944	68.1	.36	48.4	.34			77.4	.07
1945	130.2	.36	122.0	.34			115.4	.07
1946	121.7	.36	76.6	.34			58.8	.07
1947	164.2	.36	108.2	.34			108.4	.07
1948	130.7	.36	118.8	.34			127.8	.07
1949	68.0	.36	70.2	.34			65.1	.07
1950	76.9	.36	99.0	.34			126.7	.07
1951	65.7	.36[k]	78.7	.34[k]			99.6	.11[k]
1952	92.1	.44[l]						

Table 2--Continued.

Year	N. Platte, Neb. Index	Weight	Dickinson, N. D. Index	Weight	Fargo, N. D. Index	Weight	Computed Index
1900							199.0
1901							8.2
1902							105.4
1903							---
1904							70.3
1905							116.4
1906							109.6
1907	122.8	.04[e]	148.2	.11[e]			101.5
1908	237.3	.04	154.8	.11			99.7
1909	86.8	.04	173.5	.11			109.2
1910	50.9	.04	113.2	.11			101.2
1911	0.0	.04	40.7	.11			91.4
1912	48.3	.04	0.0	.11			108.0
1913	0.0	.04	125.6	.11			69.5
1914	32.4	.04[f]	73.2	.06[f]	77.8	.23[f]	86.9
1915	237.6	.04[g]	202.0	.06[g]	187.5	.13[g]	136.0
1916	154.1	.04	164.2	.06	132.2	.13	118.5
1917	35.3	.04	43.3	.06	93.3	.13	118.8
1918	30.8	.04	25.1	.06	19.1	.13	76.5
1919	142.0	.04	1.8	.06	59.1	.13	74.5

Table 2--Continued.

Year	N. Platte, Neb. Index	N. Platte, Neb. Weight	Dickinson, N. D. Index	Dickinson, N. D. Weight	Fargo, N. D. Index	Fargo, N. D. Weight	Computed Index
1920	142.5	.04	115.4	.06	134.3	.13	109.8
1921	80.5	.04	18.6	.06	82.5	.13	85.0
1922	58.1	.04	207.2	.06	125.8	.13	100.9
1923	198.1	.04	144.6	.06	103.6	.13	117.5
1924	178.4	.04	180.6	.06	142.3	.13	132.2
1925	64.6	.04	81.3	.06	132.6	.13	83.2
1926	9.3	.04	30.8	.06	103.4	.13	99.6
1927	134.3	.04	141.6	.06	107.2	.13	109.8
1928	188.4	.04	175.6	.06	114.5	.13	114.7
1929	111.8	.04	72.0	.06	108.5	.13	116.5
1930	199.8	.04	90.2	.06	129.5	.13	110.4
1931	112.4	.04	6.8	.06	46.6	.13	93.0
1932	55.5	.04	115.1	.06	108.8	.13	119.3
1933	71.3	.04	53.0	.06	41.4	.13	68.3
1934	2.9	.04	49.6	.06	64.1	.13	32.4
1935	---	---	79.1	.06[h]	123.7	.13[h]	114.2
1936	76.9	.04	0.0	.06	14.4	.13	73.9
1937	60.5	.04[i]	16.2	.06[i]	71.0	.13[i]	120.6
1938	142.7	.04	43.0	.06	101.8	.13	85.6
1939	134.5	.04[j]	178.6	.06[j]	87.0	.13[j]	85.9
1940	0.0	.04	73.6	.06	42.6	.13	84.8
1941	183.7	.04	51.2	.06	79.3	.13	102.2
1942	117.1	.04	191.0	.06	115.4	.13	110.0
1943	0.0	.04	148.3	.06	134.1	.13	110.3
1944	142.0	.04	194.8	.06	111.3	.13	78.2
1945	141.7	.04	125.7	.06	121.4	.13	125.4
1946	125.9	.04	116.6	.06	135.5	.13	103.6
1947	117.7	.04	141.5	.06	105.5	.13	130.4
1948	83.5	.04	128.1	.06	105.1	.13	121.1
1949	92.0	.04	51.9	.06	120.8	.13	75.4
1950	31.3	.04	117.2	.06	88.5	.13	90.0
1951			130.9	.06[k]	130.9	.13[k]	86.2
1952			64.6	.12[l]	78.5	.44[l]	82.8
1953					87.3	1.00[m]	87.3

a. Indexes at each location were computed using the procedure indicated in Chapter II. Raw data used are presented in Appendix A.

b. 1900-02: Columbia, Mo., weight includes 100 percent of production.

Table 2--footnotes--continued.

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c. 1904: Urbana, Ill., weight includes production from Ill., Wisc., Ind., Mich., Ohio, N. Y., Pa., Me., Vt., N. J., Md., W. Va., Va., N. C., S. C., Ga., Ala., Ky., and Tenn. Columbia, Mo., weight includes production from Mo., Ark., La., Miss., Kan., Okl., Texas, N. M., Col., Utah, Calif., Wash., Ore., Idaho, Mont., Wyo., N. D., S. D., Neb., Minn., and Iowa.

d. 1905-06: Urbana, Ill., weight same as 1904 (See c). Columbia, Mo., weight includes production from Mo., Ark., La., Miss., Minn., and Iowa. Lincoln, Neb., weight includes production from Neb., N. D., S. D., Wash., Ore., Idaho, Mont., Wyo., Col., Utah, Calif., Kan., Okl., Texas, and N. M.

e. 1907-13: Urbana, Ill., weight same as 1904 (See c). Columbia, Mo., weight includes production from ½ Minn., ½ Iowa, Mo., Ark., La., and Miss. Lincoln, Neb., weight includes production from 3/4 Neb., ½ S. D., ½ Minn., ½ Iowa, 3/4 Kan., 3/4 Okl., and 3/4 Texas. N. Platt, Neb., weight includes production from ¼ Neb., ¼ Kan., ¼ Okl., ¼ Texas, Col., N. M., Utah, and Calif. Dickinson, N. D., weight includes production from ½ S. D., N. D., Mont., Wash., Ore., Idaho, and Wyo.

f. 1914: Urbana, Ill., weight same as 1904 (See c). Columbia, Mo., weight same as 1914 except minus ½ Minn. (See f). Lincoln, Neb., weight includes production from 3/4 Neb., ½ Iowa, 3/4 Kan., 3/4 Okl., and 3/4 Texas. N. Platte, Neb., weight same as 1907-13 (See f). Dickinson, N. D., weight includes production from ¼ N. D., ¼ S. D., Mont., Wash., Ore., Idaho, and Wyo. Fargo, N. D., weight includes production from 3/4 N. D., 3/4 S. D. and Minn.

g. 1915-34: Urbana, Ill., weight same as 1904 minus ½ Wisc. (See c). Ames, Iowa, weight includes production from ½ Wisc., 3/4 Minn., and Iowa. Columbia, Mo., weight same as 1914 minus ½ Iowa (See f). Lincoln, Neb., weight same as 1914 minus ½ Iowa (See f). N. Platte, Neb., and Dickinson, N. D., weights same as 1914 (See f). Fargo, N. D., weight includes production from 3/4 N. D., 3/4 S. D., and 1/4 Minn.

h. 1935-36: All weights same as 1915-34 (See g), except that N. Platte, Neb., and Lincoln, Neb., weights are now combined.

i. 1937-38: All weights same as 1915-34 (See g).

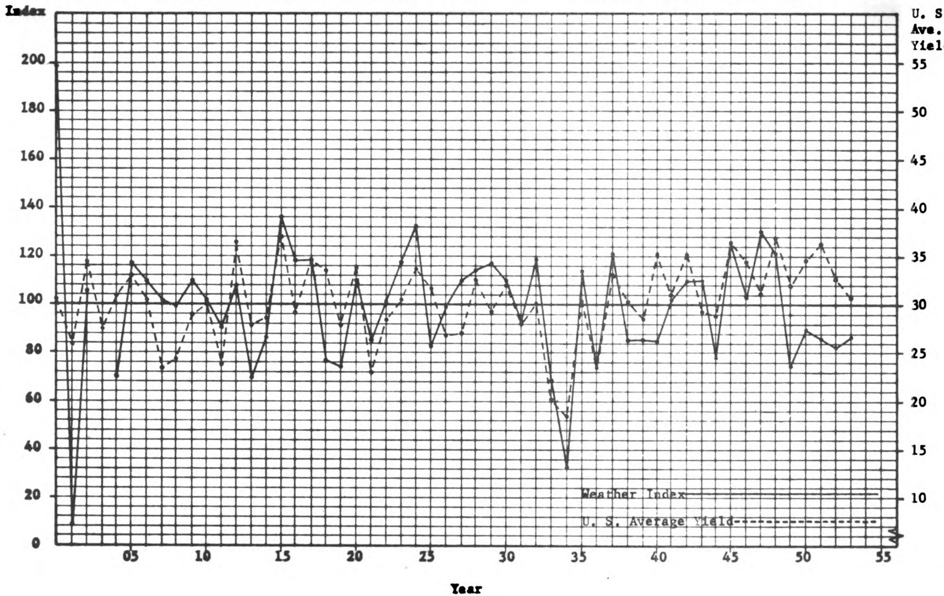
j. 1939-50: Urbana, Ill., weight same as 1915-34 except now contains Miss. Ames, Iowa, weight same as 1915-34 except now contains Mo., Ark., and La. Lincoln, Neb., and N. Platte, Neb. Dickinson, N. D., and Fargo, N. D., weights same as 1915-34 (See g).

k. 1951: All weights same as 1939-50 (See j) except that N. Platte, Neb., and Lincoln, Neb., weights are now combined.

l. 1952: Urbana, Ill., weight same as 1904 (See c) plus Mo., Ark., La., and Miss. Dickinson, N. D., weight includes production from ¼ N. D., ¼ S. D., ½ Neb., ½ Kan., ½ Okl., ½ Texas, Wash., Ore., Idaho, Mont., Wyo., Calif., Utah, Col., and N. M. Fargo, N. D., weight includes production from 3/4 N. D., 3/4 S. D., ½ Neb., ½ Kan., ½ Okl., ½ Texas, Minn. and Iowa.

m. 1953: Fargo, N. D., weight includes 100 percent of production.

Figure 4: Comparison of the Index of the Influence of Weather on Oats with U. S. Average Yield of Oats.



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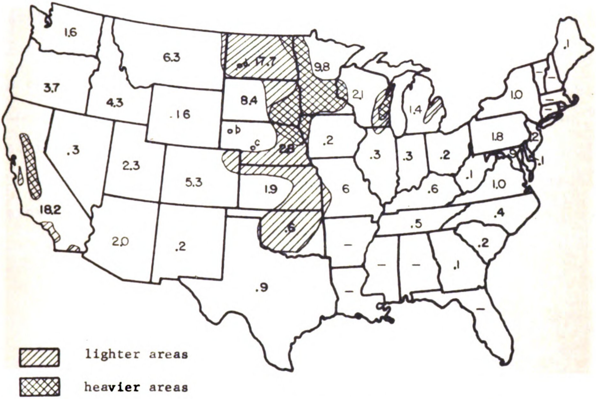
Barley

Most of the barley in the United States is produced in the western states, upper Minnesota, and North Dakota. In most U.S.D.A. publications it is classified as a feed grain; but, actually, approximately 35 percent of the barley is used in producing malt as compared to approximately 50 percent which is used for livestock feed.[1] The rest goes mostly for seed and export.

Almost 90 percent of the barley is grown west of the Mississippi River (See Figure 5). The area of greatest concentration is in eastern North Dakota and the adjacent Red River Valley area of Minnesota. From a total value standpoint barley is less important than the other crops in this study, making up only 1.83 percent of the total value of all crops and 5.8 percent of the value of feed grains in 1947-49 (See Table 8, Page 86). However, in the process of obtaining other data, data on barley were found from Alliance, Nebraska: N. Platte, Nebraska; and Dickinson, North Dakota; and it was felt that an index should be computed. Admittedly more data would be desired. Data from eastern North Dakota, southeastern South Dakota, and California would be especially desirable but were considered not worth the time and effort at this time considering the importance of barley compared to all crops.

1. Estimated for 1947-49 from Agricultural Statistics, USDA, 1955.

Figure 5: Location of Barley Production and Average Percentage of Total Production by States, 1944-53.[a]



a/ Average percentage of production from production for 1944-53 reported in Crops and Markets, USDA, AMS, 1956 edition, Vol. 33. General boundaries of greatest production derived from Van Royen, W., Agricultural Resources of the World, Prentice-Hall, 1954, Vol. 1.

b/ Alliance, Neb.

c/ N. Platte, Neb.

d/ Dickinson, N. D.

Computations of the index for the United States including computed indexes at each location and weights are presented in Table 3. A comparison of the index with United States average yield is presented in Figure 6. It will be noted that the weather index for barley fluctuates through a rather wide range compared to the indexes for other crops in this chapter. Part of this wide fluctuation may be due to rather scanty data; but it is also felt that this should be expected due to the high variability of weather in the areas from which the series were obtained.

TABLE 3: COMPUTATION OF THE INDEX OF THE INFLUENCE

OF WEATHER ON BARLEY[a]

	Alliance, Neb.		N. Platte, Neb.		Dickinson, N. D.		Computed
Year	Index	Weight	Index	Weight	Index	Weight	Index
1907			166.2	.42[b]	170.4	.58[b]	168.6
1908			157.6	.42	130.4	.58	141.8
1909			85.4	.42	182.8	.58	141.9
1910			68.5	.42	109.0	.58	92.0
1911			0.0	.42	57.8	.58	33.5
1912			70.5	.42	0.0	.58	29.6
1913			44.0	.42	114.3	.58	84.8
1914			53.8	.42	125.3	.58	95.3
1915			149.2	.42	238.2	.58	200.8
1916			135.0	.42	130.3	.58	132.3
1917			95.2	.42	40.2	.58	63.3
1918			57.8	.42	14.4	.58	32.6
1919			152.8	.42	4.4	.58	66.7
1920			107.0	.42	127.3	.58	118.8
1921			108.0	.42	32.3	.58	64.1
1922			45.6	.42	183.6	.58	125.6
1923			158.8	.42	131.2	.58	142.8
1924			149.6	.42	114.1	.58	129.0
1925			78.0	.42	47.4	.58	60.3
1926			17.8	.42	14.0	.58	15.6
1927			150.1	.42	128.2	.58	137.4
1928			205.3	.42	151.5	.58	174.1
1929			141.2	.42	42.4	.58	83.9
1930			169.8	.42	106.4	.58	133.0
1931			99.1	.42	10.0	.58	47.4
1932			68.2	.42	159.3	.58	121.0
1933			81.4	.42	46.2	.58	61.0
1934			6.0	.42	39.4	.58	25.4
1935			---	---	110.5	1.00[c]	110.5
1936			---	---	---	---	---
1937			92.2	.42	47.0	.58[b]	66.0
1938			66.9	.42	62.6	.58	64.4
1939			123.7	.42	199.2	.58	167.5
1940			0.0	.42	112.4	.58	65.2
1941	120.5	.31[d]	148.7	.13[d]	57.2	.56[d]	88.7
1942	70.6	.42[e]			207.0	.58[e]	149.7
1943	40.0	.42			131.8	.58	93.2
1944	15.9	.42			144.7	.58	90.6
1945	197.1	.42			99.6	.58	140.6
1946	128.1	.42			89.2	.58	105.5

Table 3--Continued.

Year	Alliance, Neb. Index	Alliance, Neb. Weight	N. Platte, Neb. Index	N. Platte, Neb. Weight	Dickinson, N. D. Index	Dickinson, N. D. Weight	Computed Index
1947	164.3	.42			129.8	.58	144.3
1948	99.4	.42			145.6	.58	126.2
1949	127.7	.42			38.2	.58	75.8
1950	---	---			120.2	1.00[f]	120.2
1951	100.7	.42[e]			179.2	.58[e]	146.2
1952	80.0	.42			82.8	.58	81.6
1953	55.7	1.00[g]					55.7

a. Indexes at each location were computed using the procedure indicated in Chapter II. Raw data used are presented in Appendix A.

b. 1907-34, 1937-40: N. Platte, Neb., weight contains production from Neb., Kan., Okl., Texas, Col., Utah, Nev., Calif., Ariz., N. M., Iowa, Mo., Ill., Ind., Ohio, Pa., Md., N. J., Del., W. Va., Va., N. C., S. C., Ga., Ky., and Tenn. Dickinson, N. D., weight includes production from N. D., S. D., Wash., Ore., Idaho, Mont., Wyo., Minn., Wisc., Mich., N. Y., and Me.

c. 1935-36: Dickinson, N. D., weight contains 100 percent of all production.

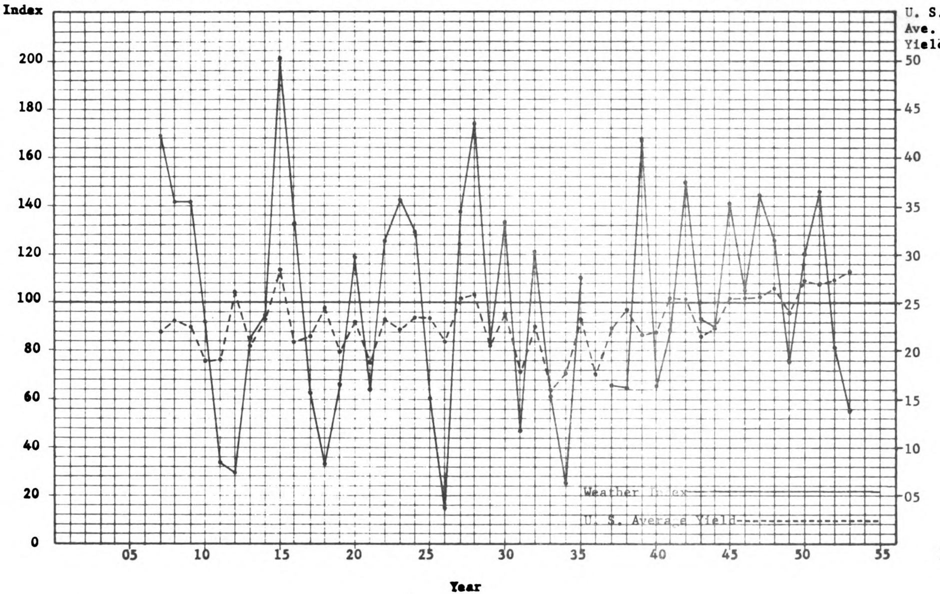
d. 1941: Alliance, Neb., weight includes production from ¼ Neb., Wyo., Col., Utah, Nev., Calif., Ariz., and N. M. N. Platte, Neb., weight includes production from 3/4 Neb., Kan., Okl., Texas, Iowa, Ill., Ind., Ohio, Mo., Ky., Tenn., Pa., N. J., Del., Md., W. Va., N. C., S. C., and Ga. Dickinson, N. D., weight includes production from Wash., Ore., Idaho, Mont., N. D., S. D., Minn., Wisc., Mich., N. Y., and Me.

e. 1942-49; 1951-52: Alliance, Neb., weight same as N. Platte, Neb., weight of 1907-34 and 1937-40 (See b). Dickinson, N. D., weight same as 1907-34 and 1937-40 (See b).

f. 1950: Dickinson, N. D., weight contains 100 percent of all production.

g. 1953: Alliance, Neb., weight contains 100 percent of all production.

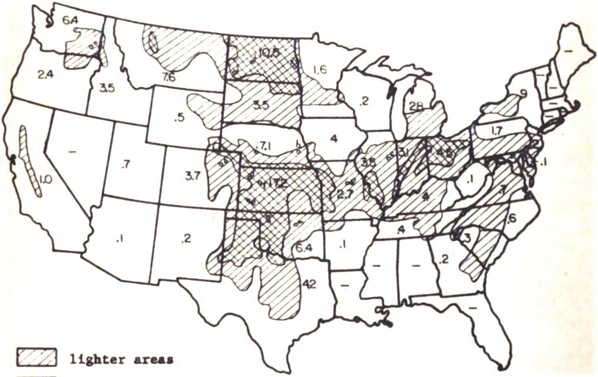
Figure 6: Comparison of the Index of the Influence of Weather on Barley with U. S. Average Yield of Barley.



Wheat

Wheat is the most important food grain. It accounted for ninety-one percent of all food grains and over ten percent of all crops from a total value standpoint in 1947-49 (See Table 8, page 86). Some wheat is grown in almost every state of the United States and production is not as highly concentrated in one large area as is the case with some other crops such as corn. Also, there are several types of wheat grown including white wheat, hard red spring, durum, hard red winter, soft red winter and other less important types. Important areas of production can be isolated, however (See Figure 7). The most important area is the Great Plains region which can be further divided into two distinct areas. These include a heavy concentration in Kansas, western Oklahoma, and the Texas Panhandle; and another distinct concentration in North Dakota, northern South Dakota, and Montana. The first area is mostly hard red winter wheat while the latter is made up mostly of hard red spring and durum wheats. Another important concentration is found in the Pacific Northwest with the heart in southeast Washington, northeast Oregon, and northwest Idaho. This is mostly white wheat. The remaining regions are more scattered. There is, however, a rather concentrated area of soft red winter wheat extending through Illinois, Indiana, and Ohio and smaller areas of white wheat in Michigan and northwestern New York.

Figure 7: Location of Wheat Production and Average Percentage of Total Production by States, 1946-55.[a]



lighter areas

heavier areas

[a]/ Average percentage production computed from production for 1946-55 reported in Crop Production, USDA, AMS, Nov. 12, 1957. General boundaries of greatest production derived from Van Royen, W., Agricultural Resources of the World, Prentice-Hall, 1954, Vol. 1.

b/ Akron, Col.
c/ Urbana, Ill.
d/ Colby, Kan.
e/ Garden City, Kan.
f/ Hays, Kan.
g/ Columbia, Mo.
h/ Lincoln, Neb.
i/ N. Platte, Neb.
j/ Dickinson, N. D.
k/ Fargo, N. D.
l/ Mandan, N. D.
m/ Stillwater, Okl.
n/ Woodward, Okl.
o/ Pullman, Wash.

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An attempt was made to obtain data which best represented the various areas, type of wheat, and production practices. This amounted roughly to an attempt to obtain data from states with five or more percent of the total value of wheat production in 1947-49. Usable data obtained included series from Akron, Colorado; Urbana, Illinois; Colby, Kansas; Garden City, Kansas; Hays, Kansas; Columbia, Missouri; Lincoln, Nebraska; North Platte, Nebraska; Dickinson, North Dakota; Fargo, North Dakota; Mandan, North Dakota; Stillwater, Oklahoma; Woodward, Oklahoma; and Pullman, Washington. It was decided that these data would be adequate for this study. There are, however, some weaknesses which should be mentioned. In the first place, as was mentioned earlier, total wheat production is not as localized as some other crops such as corn. One important gap in the data were series to represent wheat production for both soft red winter and white wheat east of the Mississippi River. It will be noted in Figure 7 that this large area includes over twenty percent of the wheat production, but that production is widely scattered. It was felt that data for Illinois, Indiana, and Ohio would be adequate if they could be obtained since these states account for approximately sixty percent of the wheat produced in that area. Data were obtained, however, only for Urbana, Illinois. Considering the low variability of yields in this area as compared to the Great Plains and considering the time and resources needed for obtaining additional data, it was decided that Urbana, Illinois, would be used to represent this area. Data were considered more adequate for the two regions in the Great Plains. This was fortunate since the two regions in that area represented over half of the production of wheat and are the principle source of variation in the U. S. yield of wheat. It was felt that it would have been desirable if adequate series could have been obtained for a few other areas including regions in northwestern Montana, southeastern Idaho, and the Texas Panhandle. A series for the Pacific Northwest covering more years than that at Pullman, Washington, would also have been desirable.

The computation of the index for the whole United States including computed indexes at each location and weights is presented in Table 4. A comparison of the index with the United States average yield is presented in Figure 8.

TABLE 4: COMPUTATION OF THE INDEX OF THE INFLUENCE OF WEATHER ON WHEAT[a]

Year	Akron, Colo. Index	Akron, Colo. Weight	Urbana, Ill. Index	Urbana, Ill. Weight	Colby, Kan. Index	Colby, Kan. Weight	Garden City, Kan. Index	Garden City, Kan. Weight	Hays, Kan. Index	Hays, Kan. Weight
1900										
1901										
1902										
1903										
1904			48.9	.23[d]						
1905			79.1	.20[e]						
1906			98.4	.20[f]						
1907			111.0	.20[g]						
1908			110.4	.20						
1909			108.0	.20[h]			0.0	.24[h]		
1910	96.0	.09[i]	122.4	.20[i]			158.2	.11[i]	168.4	.12[i]
1911	28.6	.08[j]	134.9	.20[j]			0.0	.11[j]	6.5	.12[j]
1912	240.9	.04[k]	---	---			0.0	.11[k]	90.7	.09[k]
1913	54.0	.11[l]	96.2	.20[l]			---	---	32.5	.14[l]
1914	190.7	.04[m]	100.0	.20[m]	57.0	.02[m]	193.5	.09[m]	133.7	.09[m]
1915	167.1	.04[n]	131.6	.20[n]	113.0	.02[n]	270.0	.03[n]	79.2	.09[n]
1916	134.7	.04	106.6	.20	139.3	.02	51.9	.03	148.1	.09
1917	65.8	.04	115.5	.20	0.0	.02	0.0	.03	19.2	.09
1918	53.5	.04	83.3	.20	53.4	.02	1.8	.03	89.3	.09
1919	153.6	.04	86.6	.20	99.2	.02	307.4	.03	84.0	.09
1920	147.6	.04	116.4	.20	174.8	.02	56.1	.03	150.8	.09
1921	129.8	.04[o]	91.2	.20[o]	142.4	.02[o]	105.4	.03[o]	150.8	.04[o]
1922	6.4	.04	96.6	.20	110.1	.02	0.0	.03	104.7	.04
1923	34.8	.04[p]	90.9	.20[p]	27.6	.04[p]	13.1	.05[p]	---	---
1924	43.2	.04[q]	103.1	.20[q]	159.1	.04[q]	212.3	.03[q]	185.4	.04[q]

Table 4--Continued.

Year	Columbia, Mo. Index	Columbia, Mo. Weight	Lincoln, Neb. Index	Lincoln, Neb. Weight	N. Platte, Neb. Index	N. Platte, Neb. Weight	Dickinson, N. D. Index	Dickinson, N. D. Weight	Fargo, N. D. Index	Fargo, N. D. Weight
1900	92.2	.25[b]								
1901	135.7	.23[c]							106.3	.36[c]
1902	148.9	.23							92.2	.36
1903	66.1	.23							147.7	.36
1904	---	---							65.4	.36[d]
1905	90.4	.05[e]							---	---
1906	64.2	.03[f]							75.4	.36[f]
1907	99.0	.03[g]					198.4	.27[g]	128.6	.09[g]
1908	98.2						166.2	.27	126.6	.09
1909	75.7	.03[h]					180.6	.36[h]	---	---
1910	53.4	.03[i]					126.3	.27[i]	106.8	.09[i]
1911	120.8	.03[j]					109.2	.14[j]	45.7	.09[j]
1912	61.6	.23[k]			55.2	.07[k]	0.0	.23[k]	---	---
1913	99.9	.03[l]			43.6	.07[l]	114.2	.27[l]	140.5	.09[l]
1914	152.9	.03[m]			32.9	.07[m]	87.1	.11[m]	64.0	.09[m]
1915	89.6	.03[n]			255.0	.07[n]	189.6	.11[n]	106.2	.09[n]
1916	60.0	.03			179.0	.07	118.0	.11	33.0	.09
1917	53.6	.03			0.0	.07	50.6	.11	143.2	.09
1918	166.2	.03			12.6	.07	94.1	.11	103.5	.09
1919	66.9	.03			132.3	.07	12.9	.11	61.0	.09
1920	114.9	.03			174.3	.07	112.1	.11	94.6	.09
1921	69.3	.03[o]	107.4	.08[o]	133.9	.04[o]	29.2	.11[o]	58.6	.09[o]
1922	132.7	.03	97.3	.08	60.3	.04	160.4	.11	95.5	.09
1923	142.4	.03[p]	73.7	.08[p]	63.8	.04[p]	77.4	.11[p]	99.2	.09[p]
1924	109.9	.03[q]	166.9	.08[q]	184.8	.04[q]	138.8	.11[q]	157.8	.09[q]

Table 4--Continued.

Year	Mandan, N. D. Index	Mandan, N. D. Weight	Stillwater, Okl. Index	Stillwater, Okl. Weight	Woodward, Okl. Index	Woodward, Okl. Weight	Pullman, Wash. Index	Pullman, Wash. Weight	Computed Index
1900			206.0	.75[b]					177.5
1901			169.1	.41[c]					138.8
1902			99.1	.41					108.1
1903			164.4	.41					135.8
1904			76.0	.41[d]					66.0
1905			39.9	.75[e]					50.3
1906			73.9	.41[f]					79.0
1907			49.1	.41[g]					110.0
1908			68.9	.41					109.5
1909			114.4	.16[h]					107.2
1910			130.8	.09[i]					127.8
1911			17.4	.09[j]			115.2	.14[j]	70.8
1912			62.3	.09[k]			100.0	.14[k]	55.4
1913			49.2	.09[l]			---	---	83.7
1914	193.9	.03[m]	137.0	.09[m]			107.6	.14[m]	113.7
1915	231.5	.03[n]	85.8	.06[n]	169.1	.09[n]	99.3	.14[n]	142.7
1916	107.7	.03	51.0	.06	20.4	.09	68.3	.14	92.3
1917	76.5	.03	127.4	.06	48.0	.09	77.4	.14	72.6
1918	59.5	.03	96.1	.06	37.0	.09	58.5	.14	72.6
1919	49.6	.03	44.6	.06	91.9	.09	149.7	.14	93.8
1920	48.8	.03	147.2	.06	90.2	.09	129.3	.14	120.9
1921	6.3	.03[o]	75.7	.06[o]	179.8	.09[o]	115.3	.14[o]	97.0
1922	131.0	.03	39.7	.06	171.0	.09	104.0	.14	102.6
1923	86.4	.03[p]	90.8	.06[p]	116.7	.09[p]	135.7	.14[p]	89.0
1924	139.3	.03[q]	194.3	.06[q]	84.7	.09[q]	84.3	.14[q]	128.1

Table 4--Continued.

Year	Akron, Colo. Index	Akron, Colo. Weight	Urbana, Ill. Index	Urbana, Ill. Weight	Colby, Kan. Index	Colby, Kan. Weight	Garden City, Kan. Index	Garden City, Kan. Weight	Hays, Kan. Index	Hays, Kan. Weight
1925	73.2	.04	121.1	.20	131.2	.02	49.3	.03	42.2	.04
1926	14.9	.04	115.7	.20	59.2	.02	33.0	.03	84.0	.04
1927	190.5	.04	91.9	.20	16.8	.02	0.0	.03	34.8	.04
1928	139.5	.04[r]	---	---	213.6	.02[r]	---	---	196.1	.04[r]
1929	48.6	.04[s]	97.6	.20[s]	75.8	.02[s]	166.0	.03[s]	114.8	.04[s]
1930	153.0	.04	116.6	.20	263.8	.02	140.7	.03	140.7	.04
1931	93.0	.04	128.1	.20	121.4	.02	204.6	.03	134.2	.04
1932	28.7	.04	88.1	.20	167.0	.02	147.9	.03	168.9	.04
1933	13.4	.04	72.5	.20	0.0	.02	25.0	.03	70.6	.04
1934	26.2	.06[t]	50.4	.20[t]	24.6	.02[t]	10.9	.03	28.4	.04[t]
1935	87.8	.04[u]	71.4	.20[u]	0.0	.06[u]	0.0	.03[u]	1.8	.04[u]
1936	248.2	.04[v]	105.3	.20[v]					103.2	.06[v]
1937	166.0	.04	19.9	.20					43.2	.06
1938	190.8	.04	119.9	.20					106.6	.06
1939			88.1	.23[w]					5.6	.06[w]
1940			84.7	.23					50.8	.06
1941			75.8	.23					139.5	.06
1942			73.2	.23					53.9	.06
1943			95.9	.23					46.5	.06
1944			72.9	.23					176.6	.06
1945			100.7	.23					44.6	.06
1946			101.1	.23[x]					105.1	.06[x]
1947			134.1	.23[y]					216.2	.06[y]
1948			130.4	.23					157.8	.06
1949			106.2	.23[z]					11.3	.17[z]

Table 4--Continued

Year	Columbia, Mo. Index	Columbia, Mo. Weight	Lincoln, Neb. Index	Lincoln, Neb. Weight	N. Platte, Neb. Index	N. Platte, Neb. Weight	Dickinson, N. D. Index	Dickinson, N. D. Weight	Fargo, N. D. Index	Fargo, N. D. Weight
1925	182.6	.03	44.0	.08	41.4	.04	99.4	.11	109.1	.09
1926	61.7	.03	56.9	.08	4.5	.04	54.9	.11	98.4	.09
1927	115.0	.03	120.8	.08	91.1	.04	104.0	.11	99.4	.09
1928	91.4	.23[r]	76.0	.08[r]	215.8	.04[r]	124.8	.11[r]	113.0	.09[r]
1929	110.6	.03[s]	159.3	.08[s]	98.7	.04[s]	80.9	.11[s]	126.3	.09[s]
1930	37.4	.03	128.0	.08	278.0	.04	81.2	.11	146.4	.09
1931	154.4	.03	158.4	.08	184.9	.04	10.6	.11	132.4	.09
1932	64.1	.03	92.1	.08	.2	.04	128.2	.11	111.7	.09
1933	138.2	.03	80.4	.08	43.0	.04	44.5	.11	92.0	.09
1934	82.0	.03[t]	109.3	.08[t]	2.7	.04[t]	26.2	.23[t]	73.8	.09[t]
1935	89.7	.03[u]	87.9	.08[u]	---	---	88.0	.11[u]	66.8	.09[u]
1936	62.0	.03[v]	115.5	.08[v]	125.5	.04[v]	0.0	.11[v]	36.0	.09[v]
1937	119.9	.03	59.5	.08	32.3	.04	87.4	.11	71.5	.09
1938	94.1	.03	66.2	.08	90.8	.04	39.2	.11	125.1	.09
1939			46.0	.08[w]	134.7	.08[w]	145.9	.11[w]	107.1	.09[w]
1940			81.4	.08	33.2	.08	76.8	.11	77.6	.09
1941			53.4	.08	105.4	.08	100.7	.11	112.2	.09
1942			138.6	.08	235.8	.08	258.7	.11	174.9	.09
1943			139.0	.08	0.0	.08	133.8	.11	71.5	.09
1944			94.3	.08	67.9	.08	199.7	.11	88.1	.09
1945			117.1	.08	119.1	.08	133.8	.11	115.2	.09
1946			83.0	.08[x]	137.3	.08[x]	86.9	.28[x]	115.7	.09[x]
1947			104.5	.08[y]	187.2	.08[y]	121.4	.25[y]	105.3	.09[y]
1948			91.2	.08	125.7	.08	198.0	.25	118.0	.09
1949			105.2	.08[z]	46.2	.08[z]	35.3	.27[z]	108.8	.09[z]

Table 4--Continued.

Year	Mandan, N. D. Index	Mandan, N. D. Weight	Stillwater, Okl. Index	Stillwater, Okl. Weight	Woodward, Okl. Index	Woodward, Okl. Weight	Pullman, Wash. Index	Pullman, Wash. Weight	Computed Index
1925	125.9	.03	107.3	.06	99.3	.09	116.4	.14	99.8
1926	116.6	.03	86.2	.06	128.6	.09	125.5	.14	88.6
1927	152.6	.03	23.3	.06	70.8	.09	51.2	.14	84.4
1928	113.3	.03[r]	108.0	.06[r]	106.6	.12[r]	161.4	.14[r]	122.6
1929	88.5	.03[s]	47.5	.06[s]	74.2	.09[s]	60.6	.14[s]	93.5
1930	73.3	.03	95.4	.06	99.2	.09	70.4	.14	115.9
1931	64.4	.03	131.8	.06	128.9	.09	72.2	.14	112.6
1932	151.4	.03	117.9	.06	119.8	.09	97.7	.14	102.8
1933	0.0	.03	124.4	.06	50.2	.09	31.9	.14	60.5
1934	6.1	.03[t]	162.1	.06[t]	74.5	.09[t]	---	---	54.2
1935	139.5	.03[u]	142.1	.06[u]	67.1	.09[u]	114.8	.14[u]	78.1
1936	0.0	.03[v]	89.2	.06[v]	95.4	.12[v]	82.6	.14[v]	84.9
1937	56.7	.03	137.6	.06	103.3	.12	41.6	.14	67.1
1938	76.6	.03	117.2	.06	185.5	.12	123.5	.14	114.2
1939	108.9	.03[w]	159.0	.06[w]	92.7	.12[w]	102.1	.14[w]	99.0
1940	58.3	.03	157.4	.06	54.0	.12	66.8	.14	74.2
1941	148.7	.03	81.7	.06	171.1	.12	90.9	.14	102.3
1942	139.7	.03	88.2	.06	92.7	.12	108.3	.14	130.0
1943	100.6	.03	46.4	.06	91.2	.12	185.3	.14	100.0
1944	151.5	.03	133.9	.06	136.2	.12	112.1	.14	114.9
1945	160.3	.03	96.8	.06	105.7	.12	105.1	.14	107.8
1946	---	---	129.9	.06[x]	95.2	.12[x]			101.1
1947	113.3	.03[y]	113.9	.06[y]	81.8	.12[y]			127.0
1948	124.1	.03	90.0	.06	62.7	.12			133.6
1949			100.6	.08[z]					65.8

Table 4--Continued.

Year	Akron, Colo. Index	Akron, Colo. Weight	Urbana, Ill. Index	Urbana, Ill. Weight	Colby, Kan. Index	Colby, Kan. Weight	Garden City, Kan. Index	Garden City, Kan. Weight	Hays, Kan. Index	Hays, Kan. Weight
1950			131.8	.23					80.5	.17
1951			88.4	.23					186.2	.17
1952			92.5	.23[a']					185.1	.21[a']
1953			146.8	.23[b']					26.1	.21[b']
1954										
1955										
1956										

Table 4--Continued.

Year	Columbia, Mo. Index	Columbia, Mo. Weight	Lincoln, Neb. Index	Lincoln, Neb. Weight	N. Platte, Neb. Index	N. Platte, Neb. Weight	Dickinson, N. D. Index	Dickinson, N. D. Weight	Fargo, N. D. Index	Fargo, N. D. Weight
1950			122.0	.08	98.1	.08	118.6	.27	93.4	.09
1951			85.1	.08	73.1	.08	128.6	.27'	122.7	.09
1952					87.1	.11[a']	59.8	.27[a']	67.3	.09[a']
1953					75.8	.11[b']			55.2	.36[b']
1954					54.6	.32[c']			34.9	.36[c']
1955					153.4	.32			87.3	.36
1956									147.1	.36[d']

Table 4--Continued.

Year	Mandan, N. D. Index	Mandan, N. D. Weight	Stillwater, Okl. Index	Stillwater, Okl. Weight	Woodward, Okl. Index	Woodward, Okl. Weight	Pullman, Wash. Index	Pullman, Wash. Weight	Computed Index
1950			110.7	.08					110.9
1951			78.1	.08					116.7
1952			82.2	.09[a']					99.3
1953			160.1	.09					81.9

Table 4--Continued.

Year	Mandan, N. D. Index	Mandan, N. D. Weight	Stillwater, Okl. Index	Stillwater, Okl. Weight	Woodward, Okl. Index	Woodward, Okl. Weight	Pullman, Wash. Index	Pullman, Wash. Weight	Computed Index
1954			66.3	.32[c']					51.3
1955			28.7	.32[d']					89.7
1956			75.9	.64[d']					101.5

a. Indexes at each location were computed using the procedure indicated in Chapter II. Raw data used are presented in Appendix A.

b. 1900: Columbia, Mo., weight includes production from Mo., Minn., Iowa, Ark., Wisc., Ill., Mich., Ind., Ohio, W. Va., Ky., Tenn., Ga., S. C., N. C., Va., Md., Del., Pa., N. J., and N. Y. Stillwater, Okl., weight includes production from Okl., N. D., S. D., Neb., Kan., Texas, Mont., Wyo., Col., N. M., Idaho, Utah, Ariz., Wash., Ore., and Calif.

c. 1901-03: Columbia, Mo., weight includes production from Mo., Iowa, Ark., Ill., Mich., Ind., Ohio, W. Va., Ky., Tenn., Ga., S. C., N. C., Va., Md., Del., Pa., N. J., and N. Y. Fargo, N. D., weight includes production from N. D., S. D., Minn., Wisc., Mont., Wyo., Idaho, Wash., and Ore. Stillwater, Okl., weight includes production from Okl., Neb., Kan., and Texas.

d. 1904: Urbana, Ill., weight same as for Columbia, Mo., for 1901-03 (See c). Fargo, N. D., and Stillwater, Okl., weights same as for 1901-03 (See c).

e. 1905: Urbana, Ill., weight includes production from Ill., Wisc., Mich., Ind., Ohio, W. Va., Ky., Tenn., Ga., S. C., N. C., Va., Md., Del., Pa., N. J., and N. Y. Columbia, Mo., weight includes production from Mo., Minn., Iowa, and Ark. Stillwater, Okl., weight same as for 1900 (See b).

f. 1906: Urbana, Ill., weight same as 1905 except doesn't include Wisc. (See e). Columbia, Mo., weight includes production from Mo., Iowa, and Ark. Fargo, N. D., and Stillwater, Okl., weights same as for 1901-03 (See c).

g. 1907-08: Urbana, Ill., and Columbia, Mo., weights same as 1906 (See f). Dickinson, N. D., weight includes production from $\frac{1}{2}$ N. D., $\frac{1}{2}$ S. D., Mont., Idaho, Wash., and Ore. Fargo, N. D., weight includes production from $\frac{1}{2}$ N. D., $\frac{1}{2}$ S. D., Minn., and Wisc. Stillwater, Okl., weight same as for 1901-03 (See c).

Table 4--Continued.

h. 1909: Urbana, Ill., weight same as 1906 (See f). Garden City, Kan., weight includes production from ½ Kan., ½ Neb., ½ Okl., 3/4 Texas, Col., Utah, N. M., Ariz., and Calif. Columbia, Mo., weight same as 1906 (See f). Dickinson, N. D., same as Fargo, N. D., weight for 1901-03 (See c). Stillwater, Okl., weight includes production from ½ Okl., ½ Kan., ½ Neb., and ¼ Texas.

i. 1910: Akron, Col., weight includes production from Col., Wyo., ½ Neb., Utah, and Calif. Urbana, Ill., weight same as 1906 (See f). Garden City, Kan., weight includes production from ¼ Kan., ½ Okl., and 3/4 Texas. Hays, Kan., weight includes production from ½ Kan. and ½ Neb. Columbia, Mo., weight same as 1906 (See f). Dickinson, N. D., and Fargo, N. D., weights same as 1907-08 (See g). Stillwater, Okl., weight includes production from ½ Okl., ¼ Kan., and ¼ Texas.

j. 1911: Akron, Col., weight includes production from Col., Wyo., and ½ Neb. Urbana, Ill., and Columbia, Mo., weights same as 1906 (See f). Garden City, Kan., Hays, Kan., and Stillwater, Okl., weights same as 1910 (See i). Dickinson, N. D., weight includes production from ½ N. D., ½ S. D., and Mont. Fargo, N. D., weight same as 1907-08 (See g). Pullman, Wash., weight includes production from Wash., Ore., Idaho, Calif., and Utah.

k. 1912: Akron, Col., weight includes production from Col., and Wyo. Garden City, Kan., and Stillwater, Okl., weights same as 1910 (See i). Hays, Kan., weight includes production from ½ Kan. Columbia, Mo., weight includes 1906 weights for Urbana, Ill., and Columbia, Mo., combined (See f). N. Platte, Neb., weight includes production from Neb. Dickinson, N. D., weight includes production from N. D., S. D., Mont., Minn., and Wisc. Pullman, Wash., weight same as 1911 (See j).

l. 1913: Akron, Col., weight includes production from ¼ Texas, Col., Wyo., ¼ Kan., N. M., Ariz., and Utah. Urbana, Ill., and Columbia, Mo., weights same as 1906 (See f). Hays, Kan., weight includes production from ½ Kan., ½ Texas and ½ Okl. N. Platte, Neb., weight same as 1912 (See k). Dickinson, N. D., and Fargo, N. D., weights same as 1907-08 (See g). Stillwater, Okl., weight same as 1910 (See i).

m. 1914: Akron, Col., weight includes production from Col. and Wyo. Urbana, Ill., and Columbia, Mo., weights same as 1906 (See f). Colby, Kan., weight includes production from 1/8 Kan. Garden City, Kan., weight includes production from 1/8 Kan., ½ Okl., 3/4 Texas, N. M., and Ariz. Hays, Kan., weight includes production from ½ Kan. N. Platte, Neb., weight same as 1912 (See k). Dickinson, N. D., weight includes production from ¼ N. D., ¼ S. D., and Mont. Fargo, N. D., weight same as 1907-08 (See g). Mandan, N. D., weight includes production from ¼ N. D. and ¼ S. D. Stillwater, Okl., weight same as 1910 (See i). Pullman, Wash., weight same as 1911 (See j).

Table 4--Continued.

n. 1915-20: Akron, Col., and N. Platte, Neb., weights same as 1912 (See k). Urbana, Ill., and Columbia, Me., weights same as 1906 (See f). Colby, Kan., Hays, Kan., Dickinson, N. D., and Mandan, N. D., weights same as 1914 (See m). Garden City, Kan., weight includes production from 1/8 Kan., N. M., and Ariz. Fargo, N. D., weight same as 1907-08 (See g). Stillwater, Okl., weight includes production from $\frac{1}{4}$ Okl. and $\frac{1}{4}$ Kan. Woodward, Okl., weight includes production from 3/4 Okl. and Texas. Pullman, Wash., weight same as 1911 (See j).

o. 1921-22: Akron, Col., weight same as 1912 (See k). Urbana, Ill., weight same as 1906 (See f). Colby, Kan., Dickinson, N. D., and Mandan, N. D., weights same as 1914 (See m). Garden City, Kan., Stillwater, Okl., and Woodward, Okl., weights same as 1915-20 (See n). Hays, Kan., weight includes production from Mo. and Ark. Lincoln, Neb., weight includes production from $\frac{1}{2}$ Neb., $\frac{1}{4}$ Kan., and Iowa. N. Platte, Neb., weight includes production from $\frac{1}{2}$ Neb. Fargo, N. D., weight same as 1907-08 (See g). Pullman, Wash., weight same as 1911 (See j).

p. 1923: Akron, Col., weight same as 1912 (See k). Urbana, Ill., weight same as 1906 (See f). Colby, Kan., weight includes production from $\frac{1}{4}$ Kan. Garden City, Kan., weight includes production from $\frac{1}{4}$ Kan., N. M., and Ariz. Columbia, Mo., Lincoln, Neb., and N. Platte, Neb., weights same as 1921-22 (See o). Dickinson, N. D., and Mandan, N. D., weights same as 1914 (See m). Fargo, N. D., weight same as 1907-08 (See g). Stillwater, Okl., and Woodward, Okl., weights same as 1915-20 (See n). Pullman, Wash., weight same as 1911 (See j).

q. 1924-27: All weights same as 1921-22 (See o).

r. 1928: All weights same as 1921-22 (See o) except that Urbana, Ill., and Garden City, Kan., data is missing and Columbia, Mo., weight now includes Urbana, Ill., weight and Woodward, Okl., weight now includes production from 1/8 Kan., 3/4 Okl., Texas, N. M., and Ariz.

s. 1929-33: All weights same as 1921-22 (See o).

t. 1934: All weights same as 1921-22 (See o) except that Akron, Col., weight now includes production from Col., Wyo., Utah, and Calif. Dickinson, N. D., weight now includes production from $\frac{1}{4}$ N. D., $\frac{1}{4}$ S. D., Mont., Idaho, Wash., and Ore.

u. 1935: All weights same as 1921-22 (See o) except that Colby, Kan., weight now includes N. Platte, Neb., weight of 1921-22.

v. 1936-38: All weights same as 1921-22 (See o) except that Hays, Kan., weight now includes production from 3/8 Kan. and Woodward, Okl., weight now same as 1928 (See r).

w. 1939-45: All weights same as 1936-38 (See v) except that N. Platte, Neb., weight now contains Akron, Col., weight and Urbana, Ill., weight now contains Columbia, Mo. weight.

x. 1946: All weights same as 1939-45 (See w) except that Dickinson, N. D. weight now includes Mandan, N. D., and Pullman, Wash., weights.

Table 4--Continued.

y. 1947-48: All weights same as 1946 (See x) except that Dickinson, N. D., weight now contains only Pullman, Wash., weight. Mandon, N. D., weight same as 1939-45 (See w).

z. 1949-51: Urbana, Ill., weight same as 1906 (See k) plus production from Mo. and Ark. Hays, Kan., weight includes production from $\frac{1}{2}$ Kan., 3/4 Texas, N. M., Ariz., $\frac{1}{2}$ Okl., Utah, and Calif. Lincoln, Neb., weight same as 1921-22 (See o). N. Platte, Neb., weight same as 1939-45 (See w). Dickinson, N. D., weight includes production from $\frac{1}{2}$ N. D., $\frac{1}{2}$ S. D., Mont., Idaho, Wash., and Ore. Fargo, N. D., weight includes production from $\frac{1}{2}$ N. D., $\frac{1}{2}$ S. D., Minn., and Wisc. Stillwater, Okl., weight includes production from $\frac{1}{2}$ Okl., $\frac{1}{4}$ Kan., and $\frac{1}{4}$ Texas.

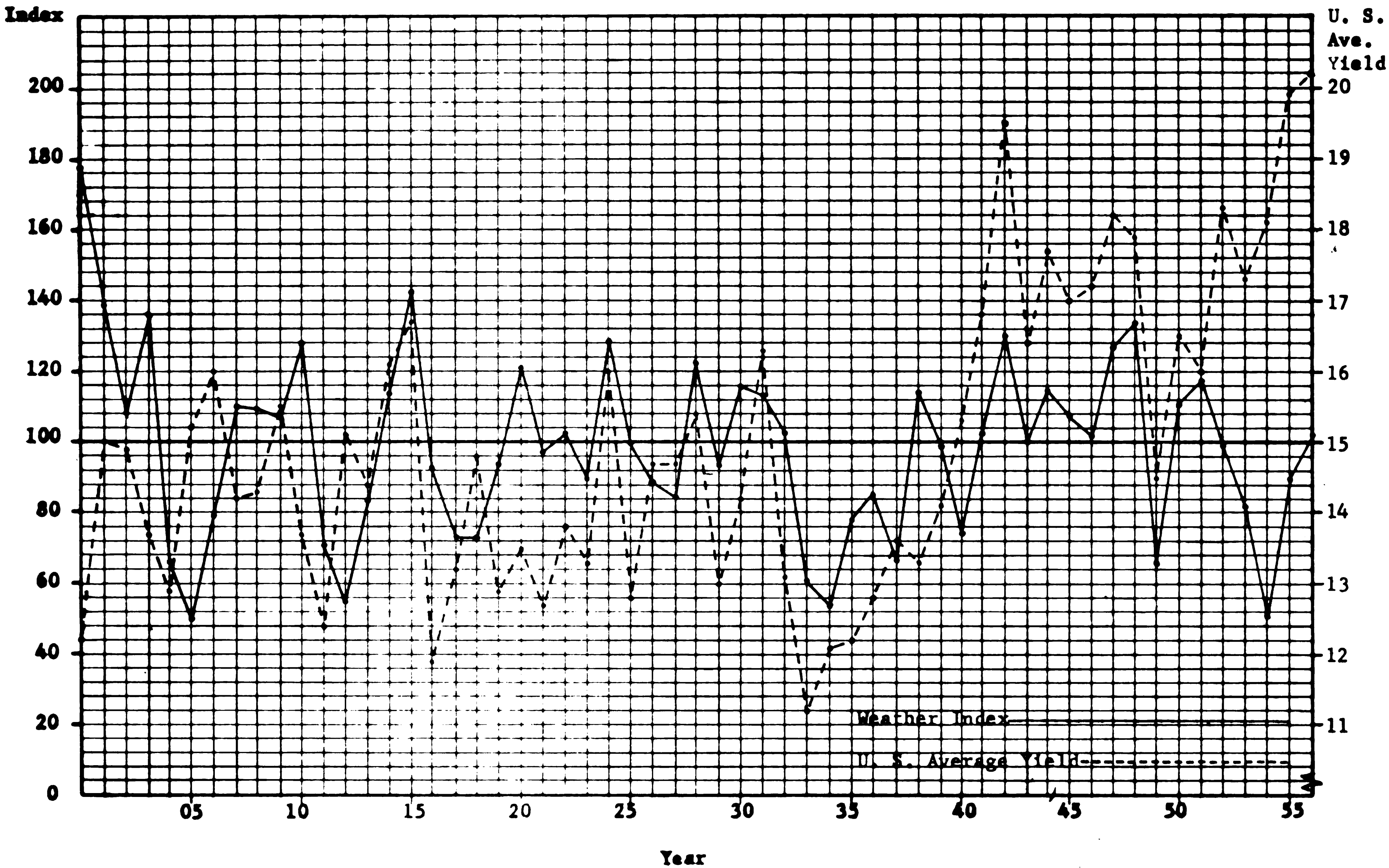
a'. 1952: Urbana, Ill., weight same as 1949-51 (See z) except now contains Iowa weight for 1949-51. Hays, Kan., weight includes production from 3/4 Kan., 3/4 Texas, $\frac{1}{2}$ Okl., N. M., Ariz., Utah, and Calif. N. Platte, Neb., weight includes production from Neb., Col., and Wyo., Dickinson, N. D., and Fargo, N. D. Stillwater, Okl., weights same as 1949-51 (See z).

b'. 1953: All weights same as 1952 (See a') except that Dickinson, N. D., and Fargo, N. D., weights are now combined.

c'. 1954-55: All weights same as 1953 (See b') except that N. Platte, Neb., weight now includes Hays, Kan., weight and Stillwater, Okl., weight now includes Urbana, Ill., weight.

d'. 1956: All weights same as 1954-55 (See c') except that Stillwater, Okl., weight now includes N. Platte, Neb., weight.

Figure 8: Comparison of the Index of the Influence of Weather on Wheat with U. S. Average Yield of Wheat.



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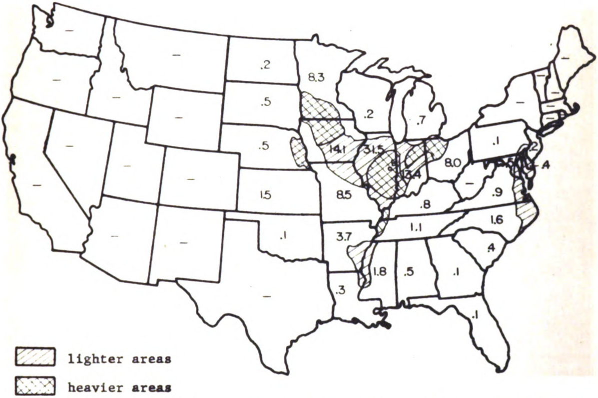
Soybeans are the most important oil crop from a total value standpoint. Although they are relatively unimportant as a percentage of total value of all crops they accounted for over 50 percent of the value of all oil crops in 1947-49 (See Table 8, page 86). The index for soybeans was computed as a single index from Urbana, Illinois. Admittedly other data would be desirable but were not readily available at this time. Data from Iowa, Indiana, and Ohio would have been especially desirable. However, if any one series could be chosen to best represent all soybean production, Urbana, Illinois, would appear to be a very good choice since it is in the center of the highest concentration of production (See Figure 9). In choosing a measure to account for weather in soybean production, Cromarty[1] used rainfall at Urbana, Illinois, with some success which should give some indication that the location may be satisfactory.

The computed index is presented in Table 5. A comparison of the index with United States average yield is presented in Figure 10.

1. Cromarty, W. A., *op. cit.*, p. 1.

Figure 9: Location of Soybean Production and Average Percentage of Total Production by States, 1946-55.[a]



a/ Average percentage production computed from production for 1946-55 reported in Crop Production, USDA, AMS, Nov. 12, 1957. General boundaries of greatest production derived from Van Royen, W., Agricultural Resources of the World, Prentice-Hall, 1954, Vol. 1.

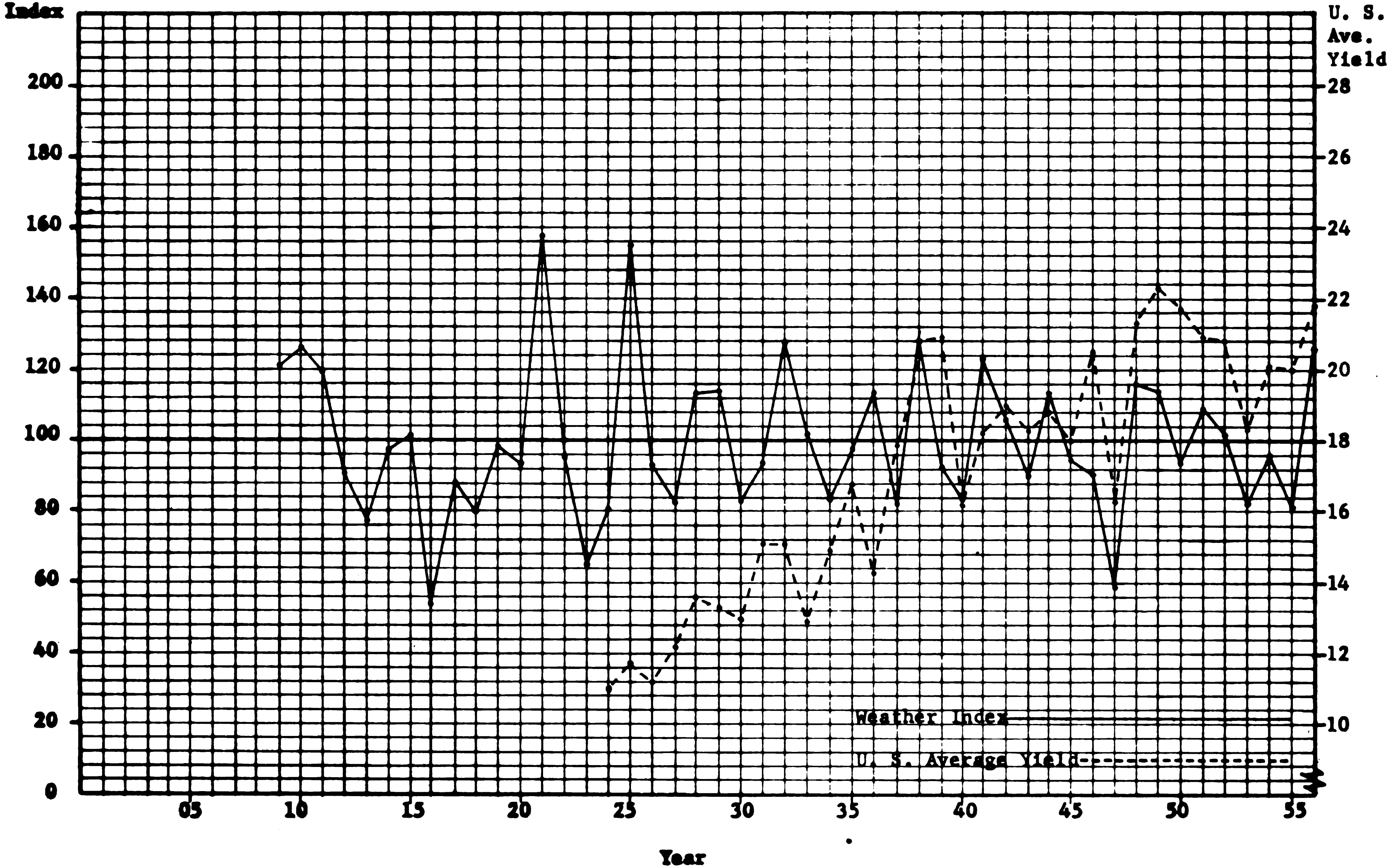
b/ Urbana, Ill.

TABLE 5: INDEX OF THE INFLUENCE OF WEATHER ON SOYBEANS[a]

Year	Index	Year	Index
1909	120.6	1934	83.9
1910	126.2	1935	97.7
1911	119.6	1936	113.6
1912	91.1	1937	82.3
1913	77.0	1938	128.0
1914	97.4	1939	92.4
1915	101.0	1940	83.9
1916	54.0	1941	123.4
1917	88.2	1942	105.7
1918	79.9	1943	90.3
1919	98.8	1944	113.5
1920	93.5	1945	95.1
1921	157.3	1946	91.0
1922	95.6	1947	59.2
1923	64.6	1948	116.0
1924	80.3	1949	113.9
1925	155.2	1950	93.7
1926	92.8	1951	108.5
1927	83.1	1952	101.7
1928	113.4	1953	82.5
1929	114.2	1954	96.0
1930	83.4	1955	81.0
1931	93.7	1956	125.9
1932	127.7	1957	110.8
1933	101.6		

a. Computed from a single location at Urbana, Ill. Three segments were computed separately due to variety changes. These segments were 1909-25, 1926-49, and 1950-57. The first two segments were computed by the usual procedure of removing trend and computing the index about this trend as described in Chapter II. The 1950-57 segment was computed as percent of average yield since it was felt the series was too short for a trend to be meaningful.

Figure 10: Comparison of the Index of the Influence of Weather on Soybeans with U. S. Average Yield of Soybeans.



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Cotton

Cotton ranks next to corn among all crops in total value of production for the United States.[1] One of the chief producing areas includes what is called the "old cotton south" which is a belt extending across the southeastern part of the United States including chiefly North Carolina, South Carolina, Georgia, Alabama, Mississippi, Tennessee, Arkansas, Louisiana, and parts of surrounding states. Other major areas include the humid area of the eastern part and the Gulf coast of Texas, subhumid areas in the Panhandle and Rio Grande Valley of Texas and the irrigated areas of New Mexico, Arizona, and California.

Most of the cotton grown is the short staple type, but relatively small acreages of American Egyptian or long staple cotton are grown in Texas, New Mexico, and Arizona.[2] The bulk of the cotton is grown without irrigation but some is grown on irrigated land in the southwestern United States. Over 1/3 of the cotton in the high plains of northwestern Texas and about 80 percent of the cotton grown in the upper and lower Rio Grande Valley of Texas is irrigated.[3] This is roughly 40 percent of the cotton acreage of Texas. Approximately 80 percent of the acreage of New Mexico, Arizona, and

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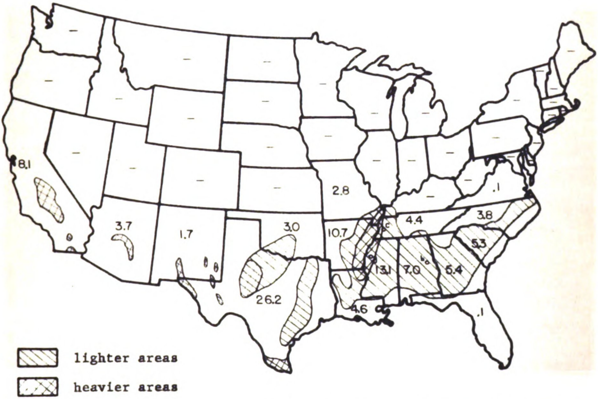
1. See Table 19, U.S.D.A., Agriculture Handbook No. 118, Vol. 2, Agricultural Production and Efficiency.
2. See U.S.D.A., Agricultural Statistics, 1956.
3. Estimated from U. S. Census of Agriculture, 1954, U. S. Bureau of the Census, Vol. III, Special Reports, Part 9, Cotton Producers and Cotton Production and from U.S.D.A. Crops and Markets.

California combined is irrigated also.[1] In constructing the index for the whole United States, it was assumed that weather has little or no influence on irrigated acreage; thus, the New Mexico, Arizona, and California areas are assigned an index of 100 each year along with 40 percent of the Texas acreage. Location of cotton production in the United States is presented in Figure 11.

An attempt was made to obtain plot data for cotton representing the bulk of the non-irrigated acreage. This would include roughly North Carolina, South Carolina, Georgia, Alabama, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and 60 percent of Texas. Data were obtained for Stoneville, Mississippi; Jackson, Tennessee; and several locations in Alabama. Admittedly more data would be desirable but it was felt that an index constructed from these three locations should give a good indication of the influence of weather on cotton production. Figure 11 indicates that Alabama data might represent, fairly well, the influence of weather on most of the acreage in Alabama and Georgia which accounts for a large percentage of the non-irrigated cotton production. Jackson, Tennessee, can represent a large part of the acreage in Tennessee, Missouri, and part of Arkansas, while Stoneville, Mississippi, can represent, fairly well, production in the Mississippi-Arkansas-Louisiana region. Major gaps include data from Texas, Oklahoma, and the Piedmont region of the southeastern United States.

1. See footnote 3, p. 65 of this study.

Figure 11: Location of Cotton Production and Average Percentage of Total Production by States, 1944-53.[a]



a/ Average percentage production computed from production for 1944-53 as reported in Crops and Markets, USDA, AMS, 1956 edition, Vol. 33. General boundaries of greatest production derived from Van Royen, W., Agricultural Resources of the World, Prentice-Hall, 1954, Vol. 1.

b/ Auburn, Ala.

c/ Jackson, Tenn.

d/ Stoneville, Miss. (Delta Branch Experiment Station)

Considering the fact that the data were less than could be desired but also considering the importance such an index might have in various studies on cotton, it was decided to construct the index from these data. Construction of the index with the separate indexes and weights used is presented in Table 6. A comparison of the index to United States average yields is presented in Figure 12.

TABLE 6: COMPUTATION OF THE INDEX OF THE INFLUENCE OF WEATHER ON COTTON[a]

	Alabama		Stoneville, Miss.		Jackson, Tenn.		Computed
Year	Index	Weight	Index	Weight	Index	Weight	Index
1900	172.1	.76[d]					154.8
1901	182.2	.76					162.5
1902	118.4	.76					114.0
1903	137.0	.76					128.1
1904	127.3	.76					120.7
1905	126.2	.76					119.9
1906	105.2	.76					104.0
1907	112.4	.76					109.4
1908	106.5	.76					104.9
1909	87.0	.76					90.1
1910	85.1	.76					88.7
1911	121.0	.39[e]			115.1	.37[e]	113.8
1912	109.1	.39			82.5	.37	97.1
1913	74.4	.39			126.4	.37	99.8
1914	47.1	.39			96.4	.37	78.0
1915	95.1	.39			110.8	.37	102.1
1916	---[c]	---			121.3	.76[f]	116.2
1917	---[c]	---			106.3	.76	104.8
1918	---[c]	---			52.6	.76	64.0
1919	---[c]	---			124.3	.76	118.5
1920	55.6	.39[g]			75.4	.37[g]	73.6
1921	50.2	.22[h]	100.0	.44[h]	135.2	.10[h]	92.6
1922	113.1	.22	57.6	.44	97.3	.10	84.0
1923	52.8	.22	48.9	.44	65.8	.10	63.7
1924	104.6	.22	82.9	.44	93.5	.10	92.8

Table 6--Continued

Year	Alabama Index	Alabama Weight	Stoneville, Miss. Index	Stoneville, Miss. Weight	Jackson, Tenn. Index	Jackson, Tenn. Weight	Computed Index
1925	---	---	189.6	.57[i]	112.3	.19[i]	153.4
1926	118.6	.22[j]	167.1	.44[j]	128.2	.10[j]	136.4
1927	134.4	.22	132.8	.44	106.1	.10	122.6
1928	56.4	.22	134.0	.44	90.9	.10	104.5
1929	95.6	.22	120.2	.44	94.0	.10	107.3
1930	78.0	.22	67.0	.44	68.3	.10	77.5
1931	93.4	.22	95.5	.44	98.7	.10	96.4
1932	105.4	.22	58.7	.44	107.3	.10	83.7
1933	103.3	.22	85.5	.44	91.8	.10	93.5
1934	104.6	.22	66.0	.44	83.3	.10	84.4
1935	105.7	.22	94.3	.44	55.3	.10	94.3
1936	89.1	.22	71.2	.44	102.5	.10	85.2
1937	105.1	.22	99.0	.44	122.8	.10	103.0
1938	118.4	.22	114.4	.44	110.9	.10	111.5
1939	109.0	.22	93.6	.44	84.2	.10	97.6
1940	90.6	.22	98.1	.44	97.2	.10	96.8
1941	108.4	.22	120.5	.44	85.6	.10	109.4
1942	105.8	.22	98.4	.44	133.4	.10	103.9
1943	106.3	.22	92.9	.44	99.8	.10	98.2
1944	120.6	.22	92.1	.44	88.3	.10	99.9
1945	101.4	.22	96.5	.44	107.8	.10	99.5
1946	71.6	.22	85.1	.44	139.0	.10	91.1
1947	91.7	.22	109.4	.44	91.9	.10	101.5
1948	124.0	.22	109.5	.44	118.0	.10	111.3
1949	91.9	.22	99.8	.44	129.6	.10	101.1

Table 6--Continued.

Year	Alabama Index	Alabama Weight	Stoneville, Miss. Index	Stoneville, Miss. Weight	Jackson, Tenn. Index	Jackson, Tenn. Weight	Computed Index
1950	95.8	.22	73.9	.44	89.4	.10	86.5
1951	96.0	.22	74.6	.44	99.5	.10	87.9
1952	72.4	.22	93.1	.44	76.2	.10	88.5
1953	103.9	.22	144.0	.44	77.0	.10	117.9
1954	80.0	.22	109.7	.44	79.0	.10	97.8
1955	136.5	.22	142.0	.44	125.0	.10	129.0
1956			84.0	.76[k]			87.8

a. Indexes at each location were computed using the procedure indicated in Chapter II. Raw data used are presented in Appendix A.

b. Alabama index computed from only data at Auburn, Ala., from 1900-29. From 1930-55 index computed from data from Alexandria, Aliceville, Auburn, Brewton, Monroeville, Pratteville, Sand Mountain, Tennessee Valley, and Wiregrass, Ala. These locations were so well distributed throughout Alabama, it was decided to average these into one index for Alabama for these years.

c. Data for Auburn, Ala., destroyed by fire for these years.

d. 1900-10: Alabama weight represents all non-irrigated production. For each year a weight of .24 is assigned to the irrigated production in Calif., Ariz., N. M., and 40 percent of Texas production. The index for the irrigated acreage is assumed to be 100.0 each year and this is weighted with the non-irrigated indexes for each year.

e. 1911-15: Alabama weight includes production from Ala., Ga., S. C., N. C., Va., Miss., La., and Fla. Jackson, Tenn., weight includes production from Tenn., Mo., Ark., Okl., and 60 percent of Texas. Irrigated production is assigned a weight of .24 (See d).

f. 1916-19: Jackson, Tenn., weight represents all non-irrigated production. For each year a weight of .24 is assigned to irrigated production (See d).

g. 1920: Weights same as 1911-15 (See e).

Table 6--footnotes--continued.

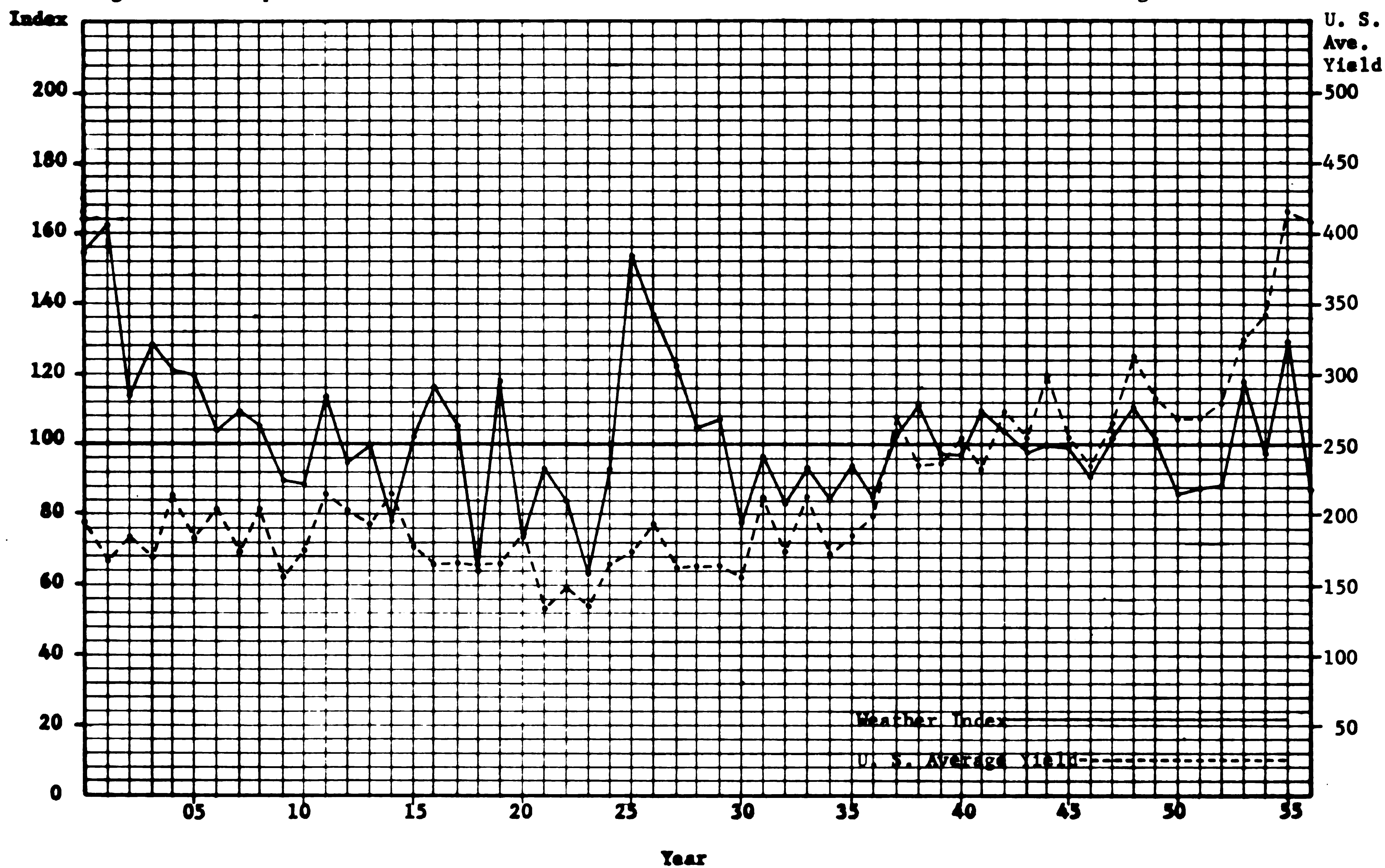
h. 1921-24: Alabama weight includes production from Ala., Ga., Fla., S. C., N. C., and Va. Stoneville, Miss., weight includes production from Miss., 3/4 Ark., Okl., La., and 60 percent of Texas. Jackson, Tenn., weight includes production from Tenn., Mo., and ¼ Ark. Irrigated production is assigned a weight of .24 (See d).

i. 1925: Stoneville, Miss., weight same as 1921-24 (See H) except now includes production from Ala., Ga., and Fla. Jackson, Tenn., weight same as 1921-24 (See h) except now includes production from S. C., N. C., and Va. Irrigated production is assigned a weight of .24 (See d).

j. 1926-55: All weights same as 1921-24 (See h).

k. 1956: Weights same as 1900-10 for Alabama (See d).

Figure 12: Comparison of the Index of the Influence of Weather on Cotton with U. S. Average Yield of Cotton.



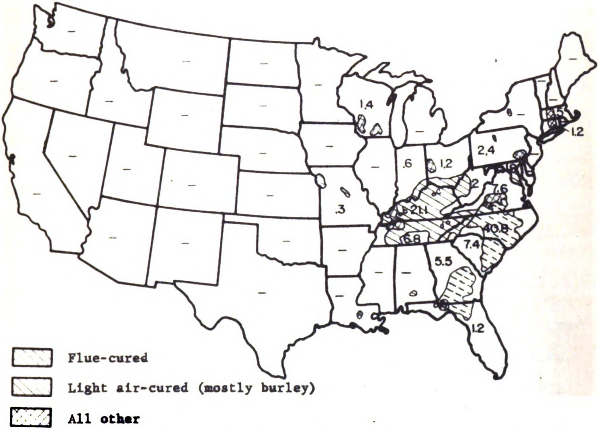
Tobacco

Tobacco is an important crop in the United States. Although the acreage is small it has a high value per acre. From a total value standpoint, it accounted for approximately five percent of the total value of crop production in the United States in 1947-49 (See Table 8, page 86). In six states, tobacco contributed 15 percent or more of the cash farm income in 1954.[1] These were Connecticut, 15 percent; Tennessee, 17 percent; Virginia, 18 percent; South Carolina, 23 percent; Kentucky, 45 percent; and North Carolina, 54 percent.

In general, tobacco is grown in rather distinct and restricted areas (See Figure 13). States with the largest acreage are North Carolina, Kentucky, Tennessee, Virginia, South Carolina, and Georgia in that order of importance. Other states with important areas in tobacco are Maryland, Pennsylvania, Ohio, Connecticut, Wisconsin, and Florida. Tobacco grown in one area possesses characteristics that distinguishes it from tobacco grown in another area. These characteristics result from the combination of soil and climatic conditions, variety of seed, methods of cultivation and fertilization, and methods of harvesting and curing. Even tobacco in the same general class sometimes differs greatly because of these factors.

1. U. S. Bureau of the Census, Census of Agriculture: 1954, Vol. III Special Reports, Chap. III, "Tobacco and Peanut Producers and Production."

Figure 13: Location of Tobacco Production and Average Percentage of Total Production by States, 1944-53.[a]



a/ Average percentage of production computed from production for 1944-53 reported in Crops and Markets, USDA, AMS, 1956 edition, Vol. 33. General boundaries of greatest production derived from Van Royen, W., Agricultural Resources of the World, Prentice-Hall, 1954, Vol. 1.

b/ Campbellsville, Ky.

c/ Lexington, Ky.

d/ Greenville, Tenn.

e/ Blacksburg, Va.

In recognition of these differences, tobacco in the several producing regions has been grouped into classes and types. A general classification is as follows:[1]

I. Cigarette, smoking and chewing types.

A. Class 1, flue-cured types.

B. Class 2, fire-cured types.

C. Class 3-A, light air-cured types (includes burley).

D. Class 3-B, dark air-cured types.

II. Cigar types.

A. Class 4, cigar-filler types.

B. Class 5, cigar-binder types.

C. Class 6, cigar-wrapper types.

III. Miscellaneous.

The two most important classes of tobacco are flue-cured and burley comprising the bulk of the production of tobacco in this country. Flue-cured is produced in Virginia, North Carolina, South Carolina, Georgia, Florida, and to a small extent in Alabama. Burley, classed as light air-cured type, is the second most important type of tobacco grown in the United States. The important states in burley production are Kentucky, Tennessee, Virginia, and North Carolina, in that order of importance. Other less important areas are in Ohio, Indiana, West Virginia, Kansas, and Missouri. The most intensive areas of production for burley are the Kentucky Blue grass subregion with its center approximately at Lexington,

1. U. S. Bureau of the Census, op. cit., p. 74.

Kentucky, the eastern and western Highland Rim of Kentucky and Tennessee and the Southern Appalacian Ridge.[1]

Other types and subtypes of tobacco are relatively less important than flue-cured and burley. The relative percentage of the total acreage of the various types during the 1950-54 period[1] were flue-cured, 62 percent; burley, 26 percent; southern Maryland, 3 percent; dark-fired and air-cured types, 4 percent; and cigar types, 5 percent.

Thus it can be seen that series for the flue-cured and burley tobacco growing areas would account for approximately 88 percent of all tobacco production. In the collection of data it was attempted to obtain data for these two major classes. Data were obtained for burley from Lexington, Kentucky; Campbellesville, Kentucky; and Greenville, Tennessee. These are fairly well located to represent all burley production. Data for flue-cured tobacco, however, could be obtained at this time only at Blacksburg, Virginia, which lies at the extreme northwest edge of the more important flue-cured producing area. The lack of more data for flue-cured tobacco from the heart of the flue-cured producing region in North Carolina is certainly a major gap. However, no further attempt will be made to obtain more data at this time.

In computing the index it was recognized that these data actually can only be taken to represent burley and flue-cured production. Thus, only burley and flue-cured production are

1. U. S. Bureau of the Census, op. cit., p. 74.

used in constructing weights. However, due to the fact that these types account for a large percentage of all tobacco production, the computed index should represent all tobacco production fairly well. If desired for certain purposes, the Blacksburg, Virginia, index could be considered an index of the influence of weather on flue-cured tobacco and the indexes for the Kentucky and Tennessee locations could be combined into an index of the influence of weather on burley.

Computation of the index for tobacco for the whole United States along with the individual indexes and weights is presented in Table 7. A comparison of the index with the United States average yield is presented in Figure 14.

TABLE 7: COMPUTATION OF INDEX OF THE INFLUENCE OF WEATHER ON TOBACCO[a]

Year	Campbellesville, Ky. Index	Campbellesville, Ky. Weight	Lexington, Ky. Index	Lexington, Ky. Weight	Greenville, Tenn. Index	Greenville, Tenn. Weight	Blacksburg, Va. Index	Blacksburg, Va. Weight	Computed Index
1924							76.0	1.00[b]	76.0
1925							103.4	1.00	103.4
1926							126.5	1.00	126.5
1927							102.0	1.00	102.0
1928							98.0	1.00	98.0
1929							107.3	1.00	107.3
1930							86.5	1.00	86.5
1931							86.0	1.00	86.0
1932					88.6	.31[c]	123.8	.69[c]	112.9
1933					94.2	.31	80.9	.69	85.0
1934					109.2	.31	120.6	.69	117.1
1935	107.6	.09[d]	99.5	.18[d]	112.3	.04[d]	113.4	.69[d]	110.3
1936	93.5	.09	68.6	.18	108.5	.04	85.7	.69	84.2
1937	107.4	.09	104.8	.18	88.1	.04	98.4	.69	100.0
1938	93.3	.09	121.8	.18	114.8	.04	94.8	.69	100.3
1939	145.8	.09	83.5	.18	90.6	.04	98.6	.69	99.8
1940	99.5	.09	98.0	.18	98.2	.04	88.6	.69	91.7
1941	86.7	.09	92.0	.18	90.8	.04	94.3	.69	93.1
1942	85.8	.09	95.3	.18	88.0	.04	106.1	.69	101.6
1943	50.9	.09	107.7	.18	93.0	.04	101.9	.69	98.0
1944	75.3	.09	122.5	.18	76.4	.04	104.7	.69	104.1
1945	127.1	.09	83.4	.18	100.2	.04	102.4	.69	101.1
1946	109.0	.09	104.5	.18	134.7	.04	104.7	.69	106.3
1947	103.2	.09	86.1	.18	113.1	.04	93.9	.69	94.1
1948	133.9	.09	106.9	.18	114.6	.04	101.5	.69	105.9

Table 7--Continued.

Year	Campbellesville, Ky. Index	Campbellesville, Ky. Weight	Lexington, Ky. Index	Lexington, Ky. Weight	Greenville, Tenn. Index	Greenville, Tenn. Weight	Blacksburg, Va. Index	Blacksburg, Va. Weight	Computed Index
1949	90.1	.09	112.2	.18	95.1	.04	95.7	.69	98.1
1950			92.3	.27[e]	102.3	.04[e]	105.2	.69[e]	101.6
1951			90.9	.27	112.5	.04	95.8	.69	95.1
1952			92.1	.27	77.6	.04	104.4	.69	100.0
1953			100.7	.27	98.6	.04	103.0	.69	102.2
1954			108.3	.27	116.3	.04	97.6	.69	101.2
1955			99.8	.27	77.4	.04	98.3	.69	97.9

a. Indexes at each location were computed using the procedure indicated in Chapter II. Raw data used are presented in Appendix A.

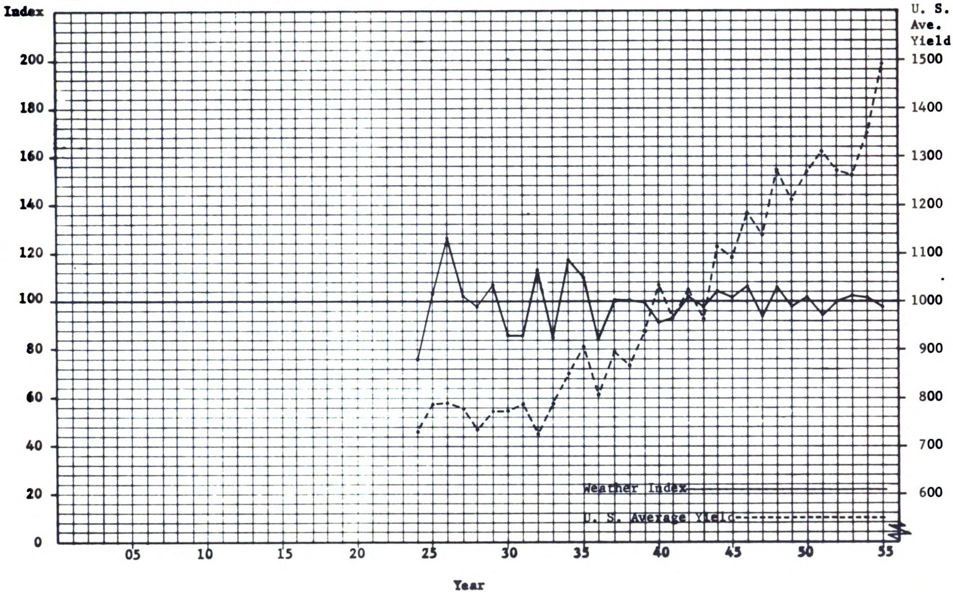
b. 1924-31: Blacksburg, Va., weight includes all production.

c. 1932-34: Since data were only obtained for burley and flue-cured tobacco and these two locations correspond to these two types, it was decided to allocate all burley production to Greenville, Tenn., and all flue-cured production to Blacksburg, Va., for these years. Weights are computed as percent of total production of burley and flue-cured combined for 1946-55 as reported in 1954 Census of Agriculture, USDA, AMS.

d. 1935-49: Weights for Campbellesville, Ky.; Lexington, Ky.; and Greenville, Tenn.; derived from weights computed by G. L. Johnson for his study of the burley tobacco control programs as reported in Ky. A.E.S. Bul. 580. Johnson had divided acreage of burley production in various states between Campbellesville, Ky., Lexington, Ky., and Greenville, Tenn., for 1940-42. Weight for Blacksburg, Va., (flue-cured tobacco) remains the same as for 1932-34 (See c).

e. 1950-55: All weights are the same as 1935-39 (See d) except that Lexington, Ky., weight now contains production for Campbellesville, Ky., in addition.

Figure 14: Comparison of the Index of the Influence of Weather on Tobacco with U. S. Average Yield of Tobacco.



CHAPTER IV

INDEXES OF THE INFLUENCE OF WEATHER ON AGGREGATE MEASURES OF U. S. AGRICULTURAL PRODUCTION AND YIELDS

In this chapter the indexes of the influence of weather on individual crops computed in Chapter III are used to construct indexes of the influence of weather on some of the more important aggregate measures of U. S. agricultural production and yields computed by the United States Department of Agriculture. In addition to the individual indexes computed in this study, an index computed from indexes of pasture conditions as reported in Agricultural Statistics was also used when appropriate.

The measures referred to above include the Index of Crop Production, the Index of Gross Farm Production, the Index of Farm Output, the Index of Farm Marketings and Home Consumption, the Index of Crop Yields per Harvested Acre, and the Feed Grain Component of these.[1] The Index of Crop Production is a measure of year-to-year changes in total production of food, feed, and nonfood crops. It is used as a measure of crop production during the current year regardless of its eventual use. The Index of Gross Farm Production is a measure of the year-to-year changes in the combined volume of total crop production, product added by all livestock

1. See U.S.D.A., Agricultural Handbook No. 118, Vol. 2, Agricultural Production and Efficiency, for a detailed discussion of each series.

and pasture consumed by all livestock. This measure includes the total contribution of farm labor and farmland, since it includes the production of commodities for eventual human use as well as "producer goods," such as farm produced power, hay-seeds, pasture seeds and cover-crop seeds. The Index of Farm Output is a measure of the current year's production of commodities for human use, even though some of the output may be sold or consumed in succeeding years. In a sense, it measures the end product of the total agricultural effort during the current year since hay and concentrates fed by horses and mules (farm produced power) hayseeds, pasture seeds, and cover-crop seeds are subtracted. The Index of Farm Marketings and Home Consumption is a measure of changes in the quantities of farm production entering the marketing system in the form of sales by farmers or as direct consumption in farmer's house-holds. All the commodities that are included in the Index of Gross Farm Production are included in this index except a few that are estimated on a value basis and for which no quantity data are available. In comparison to the above three indexes which measure production when it is produced, this index measures production when it enters the marketing system. The Index of Crop Yields Per Harvested Acre measures year-to-year changes in average level of yields of 28 crops. It is further subdivided into yield indexes of 18 field and 10 fruit crops. Only the index for 18 field crops will be considered in this study.

In constructing the indexes of the influence of weather on the various aggregate measures, the weather indexes for individual crops and the index of pasture conditions were weighted according to value of production of each during 1947-49 as presented in Tables 18, 27, 21, and 33 in U.S.D.A., Agricultural Handbook No. 81.[1] These weights are presented in Table 8. The computed weather indexes and comparisons with the appropriate U.S.D.A. indexes are presented in Table 9. For a graphic comparison of some of these see Figures 15, 16, 17, 18, 19, 20, and 21. Conceptually, some objection may be raised to using 1947-49 weights exclusively since the weights of the crops entering into each index may have changed since 1900. This is, of course, true especially in the case of the Index of Farm Output where hay and concentrates fed to horses and mules (farm produced power) are subtracted. Historically, farm-produced power has decreased from a fifth of gross farm production in the United States in 1910-14, to a tenth in 1935-39, and to about two percent in recent years.[2] In the past, the reduction in farm-produced power has been an important factor in the increase in farm output. Weights for other crops have changed also. A good example is the weight for soybeans. Recently soybeans has become a relatively important crop (See Table 8) yet production was very small in the early 1900's. It was not included in most

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1. U.S.D.A., Agricultural Handbook No. 118, Feed Consumed by Livestock, p. 82.
2. U.S.D.A., Agricultural Handbook No. 118, op. cit., p. 82.

U.S.D.A. publications until approximately the 1920's. Admitting the conceptual difficulties, however, it was decided that only the one set of weights for 1947-49 would be used. This was decided upon partly because it was assumed that the added accuracy from more detailed weights would not be worth the extra time involved, and partly because the 1947-49 weights should not cause substantial biases in the weather indexes for the span of recent years in which most persons using these indexes would be interested.

TABLE 8: PERCENTAGE OF TOTAL VALUE COMPARISONS AND COMPUTED WEIGHTS FOR USE IN CONSTRUCTING INDEXES OF THE INFLUENCE OF WEATHER ON VARIOUS AGGREGATE MEASURES, 1947-49[a]

Item	Index of Crop Production: Percentage of: Group	Index of Crop Production: Percentage of: All Crops	Index of Crop Production: Weights: Group	Index of Crop Production: Weights: All Crops	Index of Gross Farm Production: Percentage of: Group	Index of Gross Farm Production: Percentage of: All Crops and Pasture	Index of Gross Farm Production: Weights: Group	Index of Gross Farm Production: Weights: All Crops and Pasture
Feed Grains								
All Corn	74.6	23.26	.767	.366	74.6	21.32	.767	.320
Oats	16.8	5.23	.172	.082	16.8	4.79	.172	.072
Barley	5.9	1.84	.061	.029	5.9	1.68	.061	.025
Group Total	97.3	30.33	1.000	.477	97.3	27.79	1.000	.417
Food Grains								
All Wheat	91.6	13.07	1.000	.205	91.6	11.98	1.000	.180
Oil Crops								
Soybeans	52.8	2.78	1.000	.044	52.8	2.54	1.000	.038
Cotton	100.0	12.74	1.000	.200	100.0	11.68	1.000	.175
Tobacco	100.0	4.69	1.000	.074	100.0	4.29	1.000	.064
Pasture	---	---	---	---	100.0	8.36	1.000	.126
Total		63.61		1.000		66.64		1.000

a. Derived from Tables 19, 27, 31, and 34, U.S.D.A., Ag. Handbook No. 118, Vol. 2, Agricultural Production and Efficiency. Weights are computed by dividing the value of the particular crop by the value of all the crops and pasture used in each measure in this study for 1947-49.

Table 8--Continued

Item	Index of Total Farm Output: Percentage of Group	Index of Total Farm Output: Percentage of All Crops and Pasture[b]	Index of Total Farm Output: Weights Group	Index of Total Farm Output: Weights and Pasture	Index of Farm Marketings and Home Consumption: Percentage of Group	Index of Farm Marketings and Home Consumption: Percentage of All Crops	Index of Farm Marketings and Home Consumption: Weights Group	Index of Farm Marketings and Home Consumption: Weights All Crops
Feed Grains								
All Corn	73.2	19.15	.756	.293	58.9	9.99	.723	.159
Oats	17.0	4.44	.175	.068	12.1	2.05	.148	.033
Barley	6.7	1.75	.069	.027	10.5	1.78	.129	.028
Group Total	96.9	25.34	1.000	.388	81.5	13.82	1.000	.220
Food Grains								
All Wheat	91.6	12.67	1.000	.193	91.8	18.29	1.000	.291
Oil Crops								
Soybeans	52.8	2.69	1.000	.041	53.2	3.89	1.000	.062
Cotton	100.0	12.35	1.000	.189	100.0	19.31	1.000	.308
Tobacco	100.0	4.54	1.000	.069	100.0	7.48	1.000	.119
Pasture	---	7.84	1.000	.120	---	---	---	---
Total		65.43		1.000		62.79		1.000

b. Percentages were computed by adding the value of pasture consumed by livestock to the value of total crop production and subtracting the value of horse and mule feed other than pasture and the value of seeds as outlined in method B in Table 27 of U.S.D.A. Agriculture Handbook, No. 118, to get the value of Farm output from crops and pasture. The estimated value of corn, oats, and barley consumed by horses and mules was subtracted from the value of these feed grains as presented in Table 19 of U.S.D.A. Agriculture Handbook, No. 118, before percentages were computed. A telephone conversation with Glen T. Barton of the Farm Economics Research Division, ARS, U.S.D.A. revealed that these figures were not computed as such for 1947-49 so the amounts of each crop to subtract were estimated from Table 18, p. 44 of U.S.D.A. Stat. Bul. No. 145, Feed Consumed by Livestock which gives the tons of each feed grain consumed by horses and mules.

Table 8--Continued.

Item	Index of Crop Yields Per Harvested Acre			
	Percentage of		Weights	
	Group	All Crops	Group	All Crops
Feed Grains				
All Corn	74.6	27.0	.767	.378
Oats	16.8	6.1	.173	.085
Barley	5.8	2.1	.060	.029
Group Total	97.2	35.2	1.000	.492
Food Grains				
All Wheat	92.1	15.1	1.000	.211
Oil Crops				
Soybeans	54.2	3.2	1.000	.045
Cotton	100.0	12.6	1.000	.176
Tobacco	100.0	5.4	1.000	.076
Pasture	---	---	---	---

TABLE 9: INDEXES OF THE INFLUENCE OF WEATHER ON VARIOUS AGGREGATE MEASURES AND COMPARISONS WITH THESE MEASURES[a]

	Index of Crop Production				Index of Gross Farm Production[b]		Index of Farm Output[c]		
	Total Index		Feed Grain Component				Total Index		Feed Grain Component
Year	Weather Index	USDA Index	Weather Index	USDA Index	Weather Index	USDA Index	Weather Index	USDA Index	Weather Index
1900	132.5[e]	--	102.0	--	127.9[e]	--	128.4[e]	--	102.5
1901	86.0	--	27.5	--	88.0	--	87.7	--	27.4
1902	140.7	--	167.6	--	135.6	--	136.1	--	167.3
1903	118.7[f]	--	104.0	--	116.4[f]	--	116.7[f]	--	104.0
1904	85.6[g]	--	78.8	--	88.4[g]	--	88.1[g]	--	78.7
1905	107.1	--	127.4	--	107.4	--	107.4	--	127.4
1906	99.0	--	105.9	--	99.5	--	99.4	--	105.9
1907	112.7[h]	--	115.2	--	110.6[h]	--	110.8[h]	--	115.6
1908	97.1	--	88.5	--	98.4	--	98.3	--	89.1
1909	99.8[i]	--	98.8	--	99.7[i]	--	99.7[i]	--	99.3
1910	106.4	69	102.9	90	104.7	71	104.9	61	102.8
1911	84.1	67	74.1	77	84.2	70	84.3	59	73.9
1912	98.2	77	117.8	96	98.6	77	98.6	66	117.0
1913	76.7	68	63.9	75	79.1	72	78.9	60	64.1
1914	94.9	75	93.6	81	95.1	78	95.1	66	93.6
1915	128.9	78	136.8	95	127.7	80	127.8	68	137.4
1916	90.6	70	82.4	80	93.1	74	92.8	62	83.1
1917	101.6	75	114.0	96	101.7	78	101.7	65	113.5
1918	70.9	75	72.2	85	74.8	78	74.4	66	71.9
1919	103.2	76	101.3	86	104.6	78	104.5	66	100.8
1920	111.2	83	124.4	100	96.3	82	111.2	70	124.3
1921	102.4	71	103.9	91	103.3	74	103.2	62	103.4
1922	101.9	76	109.8	86	102.8	79	102.7	68	109.9
1923	97.5	76	118.4	91	98.6	79	98.5	69	118.6
1924	103.4[j]	76	103.5	77	103.6[j]	79	103.5[j]	68	103.9

Table 9--continued.

Year	Index of Farm Marketings and Home Consumption: Total Index: Weather Index	Total Index: USDA Index	Feed Grain Component: Weather Index	Feed Grain Component: USDA Index	Index of Crop Yields per Harvested Acre[c]: Total Index: Weather Index	Total Index: USDA Index	Feed Grain Component: Weather Index
1900	150.0[e]	--	100.3	--	131.7	--	102.0
1901	121.2	--	27.8	--	83.1	--	27.5
1902	125.1	--	168.6	--	141.7	--	167.6
1903	126.0[f]	--	104.0	--	118.3	--	104.0
1904	90.4[g]	--	78.9	--	84.3	--	78.8
1905	96.1	--	127.6	--	106.7	--	127.4
1906	95.2	--	105.9	--	98.8	--	105.9
1907	108.6[h]	--	119.2	--	163.3	--	115.1
1908	103.1	--	92.2	--	139.4	--	88.5
1909	100.8[i]	--	101.8	--	100.0	--	98.8
1910	107.6	58	102.1	70	106.9	--	102.9
1911	89.3	61	71.0	65	83.1	--	74.2
1912	86.5	62	111.6	67	98.2	--	117.9
1913	84.3	61	65.3	67	75.8	--	63.9
1914	95.1	61	93.8	60	95.3	--	93.6
1915	125.3	64	141.4	67	129.6	--	136.7
1916	96.2	64	85.5	70	89.7	--	82.4
1917	94.4	62	110.3	65	101.5	--	114.0
1918	69.3	67	69.3	77	71.0	--	72.3
1919	104.1	67	99.2	62	102.6	74.1	101.3
1920	103.3	64	124.2	69	112.3	80.3	124.4
1921	100.8	65	101.3	83	102.6	71.4	103.9
1922	97.7	67	111.0	75	102.4	74.7	109.7
1923	86.2	69	120.1	68	98.5	75.1	118.3
1924	103.0[j]	72	105.0	76	103.7	74.4	103.6

Table 9--continued.

Year	Index of Crop Production: Total Index: Weather Index	Index of Crop Production: Total Index: USDA Index	Index of Crop Production: Feed Grain Component: Weather Index	Index of Crop Production: Feed Grain Component: USDA Index	Index of Gross Farm Production[b]: Weather Index	Index of Gross Farm Production[b]: USDA Index	Index of Farm Output[c]: Total Index: Weather Index	Index of Farm Output[c]: Total Index: USDA Index	Index of Farm Output[c]: Feed Grain Component: Weather Index
1925	114.3	78	102.0	91	111.7	80	112.0	70	101.5
1926	96.2	80	78.2	83	96.5	82	96.4	73	77.8
1927	105.5	79	110.0	85	106.2	81	106.1	72	110.3
1928	112.7	82	114.0	90	111.4	83	111.6	75	114.6
1929	97.5	79	92.0	83	98.1	81	98.0	74	92.1
1930	82.1	76	68.7	73	82.3	79	82.3	72	69.5
1931	102.3	84	103.6	84	100.7	85	100.8	79	103.0
1932	105.3	80	112.3	95	103.8	82	104.0	76	110.4
1933	81.7	71	83.6	73	82.1	77	82.0	70	83.3
1934	69.4	58	61.0	48	69.1	67	69.1	60	60.5
1935	98.2	76	106.6	80	98.2	78	98.9	72	106.7
1936	73.0[k]	64	56.2	53	72.8[k]	71	72.8[k]	65	56.3
1937	101.5[l]	88	117.6	87	100.3[l]	87	100.4[l]	82	117.1
1938	108.7	83	104.7	84	108.2	84	108.2	79	104.2
1939	99.1	82	100.4	83	98.0	84	98.1	80	100.9
1940	84.7	85	83.2	85	86.2	87	86.1	83	83.1
1941	107.8	86	110.4	91	107.0	89	107.1	86	110.1
1942	111.8	97	109.4	104	111.8	99	111.8	96	109.8
1943	101.8	90	105.7	96	101.8	97	101.7	94	105.6
1944	101.0	96	93.9	100	101.1	99	101.0	97	93.8
1945	105.1	93	107.9	97	105.8	97	106.8	96	108.3
1946	100.5	98	104.2	105	100.9	99	100.8	98	104.2
1947	95.3	93	82.7	81	96.7	95	96.5	95	83.5
1948	120.4	106	121.1	116	118.2	104	118.4	104	121.1
1949	92.3	101	97.1	103	94.1	101	93.9	101	96.7

Table 9--Continued

Year	Index of Farm Marketings and Home Consumption				Index of Crop Yields per Harvested Acre[c]		
	Total Index		Feed Grain Component		Total Index		Feed Grain Component
	Weather Index	USDA Index	Weather Index	USDA Index	Weather Index	USDA Index	Weather Index
1925	120.1	70	99.3	66	113.1	74.5	102.0
1926	104.8	73	73.4	69	95.0	75.1	78.3
1927	104.2	73	112.0	64	105.0	77.6	110.0
1928	112.6	74	118.3	70	112.8	78.4	114.0
1929	100.2	74	91.1	63	97.2	74.0	92.1
1930	89.1	72	72.8	58	82.2	69.6	68.7
1931	100.5	73	99.7	48	102.5	75.9	103.6
1932	101.9	71	112.8	59	106.0	74.8	112.3
1933	80.9	72	82.2	63	81.4	68.2	83.6
1934	73.8	71	58.8	43	69.0	60.0	61.0
1935	94.4[k]	66	106.8	36	98.3	75.7	106.6
1936	81.0[l]	71	55.9	50	70.4	64.2	56.2
1937	93.3	74	113.8	45	101.5	84.4	117.6
1938	110.0	76	102.1	67	108.7	83.2	104.7
1939	99.6	79	105.4	71	99.1	83.8	100.3
1940	85.5	80	81.9	75	84.4	87.6	83.2
1941	106.2	82	108.9	70	107.8	89.5	110.4
1942	113.2	90	112.3	75	112.0	99.4	109.4
1943	99.6	94	104.7	74	101.9	90.0	105.7
1944	104.3	99	93.9	77	101.1	95.0	93.9
1945	104.1	99	110.0	94	105.3	94.5	107.9
1946	98.7	97	104.3	86	100.8	97.7	104.2
1947	102.1	100	86.4	93	95.1	92.2	82.7
1948	119.7	97	121.5	86	120.6	108.6	121.1
1949	90.1	103	95.8	121	92.0	99.2	97.1

Table 9--continued.

Year	Index of Crop Production: Total Index: Weather Index	Index of Crop Production: Total Index: USDA Index	Index of Crop Production: Feed Grain Component: Weather Index	Index of Crop Production: Feed Grain Component: USDA Index	Index of Gross Farm Production[b]: Weather Index	Index of Gross Farm Production[b]: USDA Index	Index of Farm Output[c]: Total Index: Weather Index	Index of Farm Output[c]: Total Index: USDA Index	Index of Farm Output[c]: Feed Grain Component: Weather Index
1950	101.7	97	104.8	104	102.4	99	102.3	100	104.9
1951	99.7	99	97.2	97	100.6	101	100.5	103	97.6
1952	96.0	103	96.6	102	96.2	105	96.2	107	96.4
1953	91.0	103	82.8	101	91.2	106	91.2	108	82.5
1954	90.1[m]	101	104.8	105	90.2[m]	105	90.2[m]	108	104.8
1955	107.3	106	110.4	112	105.8	109	105.9	113	110.4
1956	107.5[n]	106	119.4	---	107.5[n]	---	107.6[n]	114	119.4
1957	110.8[o]	---			110.8[o]	---	110.8[o]	---	

Table 9--Continued

Year	Index of Farm Marketings and Home Consumption: Total Index: Weather Index	Total Index: USDA Index	Feed Grain Component: Weather Index	Feed Grain Component: USDA Index	Index of Crop Yields per Harvested Acre: Total Index: Weather Index	Total Index: USDA Index	Feed Grain Component: Weather Index
1950	100.1	99	106.1	112	102.1	102.8	104.8
1951	101.2	101	100.9	88	100.0	101.7	97.2
1952	89.1	104	95.7	91	96.2	107.1	96.6
1953	95.2	108	80.8	107	90.3	107.1	82.8
1954	84.9[m]	108	104.8	114	90.0	108.4	104.8
1955	106.6	112	110.4	125	106.7	118.1	110.4
1956	101.7[n]	114	119.4	---	108.2	---	119.4
1957	110.8[o]	---	---	---	110.8	---	---

a. USDA indexes taken from USDA, Ag. Handbook No. 118, Vol. 2, *Agricultural Production and Efficiency*. Index for specific crops used in constructing the weather indexes are found in Chapt. III. The Index of pasture condition is computed from Table 110 of USDA Statistical Bul. 159, *Grain and Feed Statistics through 1954*. It is the average of indexes of pasture condition May through August for 1900-14 and the average of May through October for 1915-54. The index was then converted to deviations from 100 using the average value for each period as 100. In constructing the indexes for specific years the basic weights given in Table 8 were used. These were further adjusted for years when all crops or pasture were not included.

b. An index for the feed grain component is not computed for this measure because the weights are the same for feed grains as for the Index of Crop Production.

c. The USDA index for feed grains for this measure is not published so the weather index for feed grains is compared only with the total USDA index.

e. 1900-02: Individual weather indexes available for use in these years included corn, oats, wheat, cotton, and pasture. The index of Farm Production and the Index of Farm Output contain the pasture index, also.

f. 1903: Individual weather indexes available for use in this year included corn, wheat, cotton, and pasture.

g. 1904-06: Individual weather indexes available same as for 1900-02. (See e).

h. 1907-08: Individual weather indexes available for use in these years included corn, oats, barley, wheat, soybeans, cotton, and pasture.

Table 9--footnotes--continued.

i. 1909-23: Individual weather indexes available for use in these years included corn, oats, barley, wheat, soybeans, cotton, and pasture.

j. 1924-35: All individual weather indexes computed in this study available for these years including corn, oats, barley, wheat, soybeans, cotton, tobacco, and pasture.

k. 1936: All individual weather indexes available except barley.

l. 1937-53: Same as 1924-35 (See j).

m. 1954-55: All individual weather indexes available except oats and barley.

n. 1956: Individual weather indexes available included corn, wheat, soybeans, and cotton.

o. 1957: Only weather index for soybeans available.

Figure 15: Comparison of the Index of the Influence of Weather on the Index of Crop Production with the Index of Crop Production.

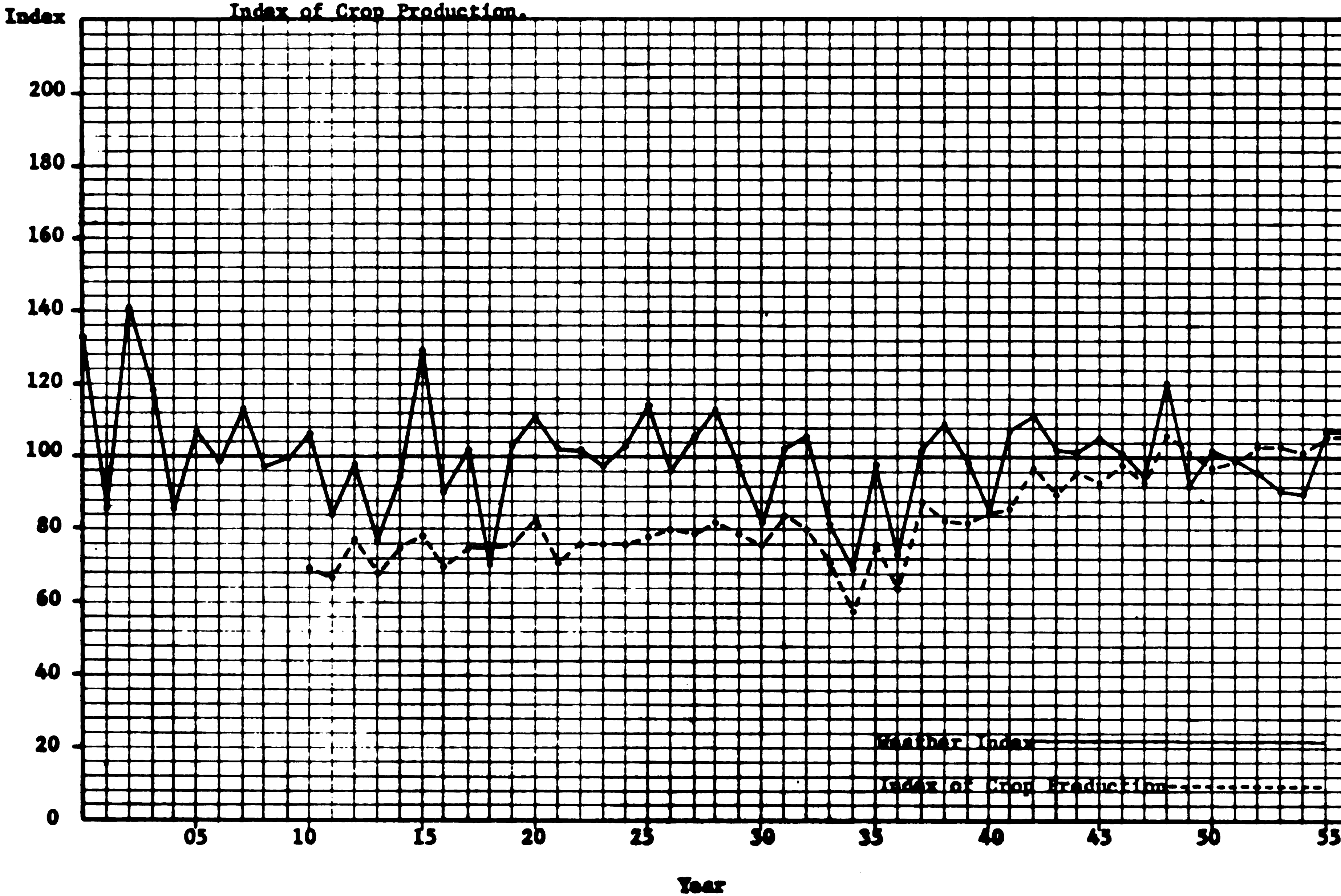


Figure 16: Comparison of the Index of the Influence of Weather on the Feed Grain Component of the Index of Crop Production with the Feed Grain Component of the Index of Crop Production.

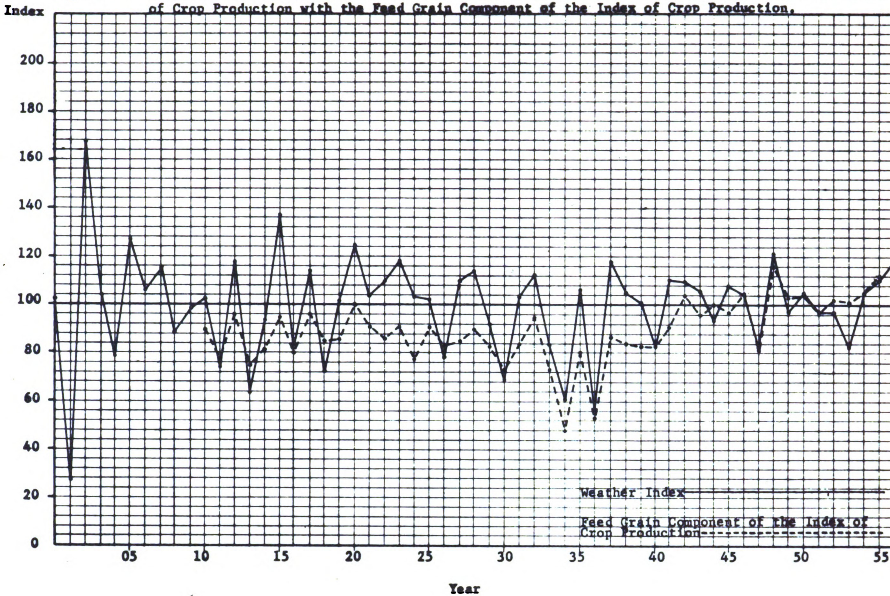


Figure 17: Comparison of the Index of the Influence of Weather on the Index of Gross Farm Production with the Index of Gross Farm Production.

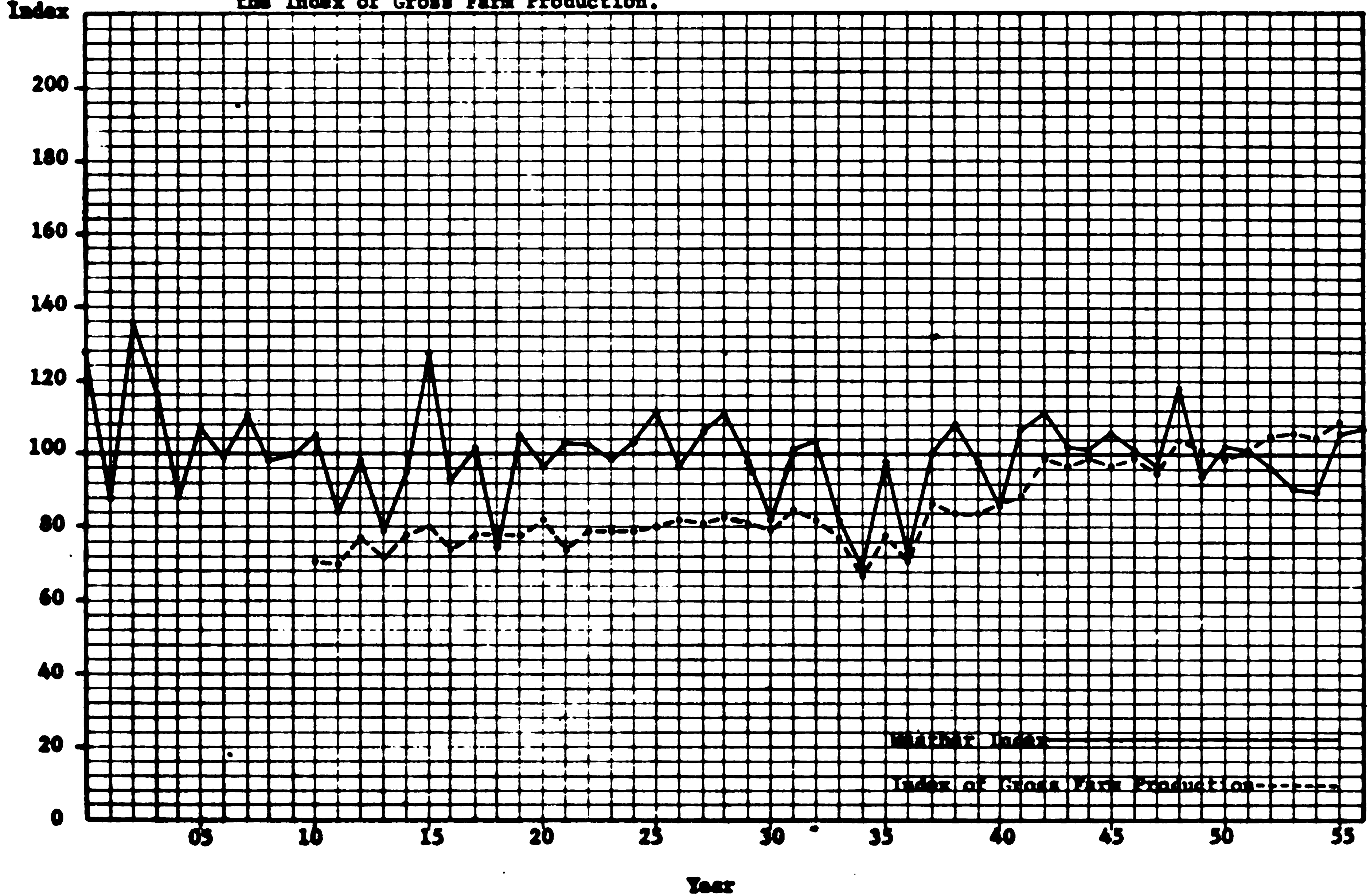


Figure 18: Comparison of the Index of the Influence of Weather on the Index of Farm Output and on the Feed Grain Component of the Index of Farm Output with the Index of Farm Output.

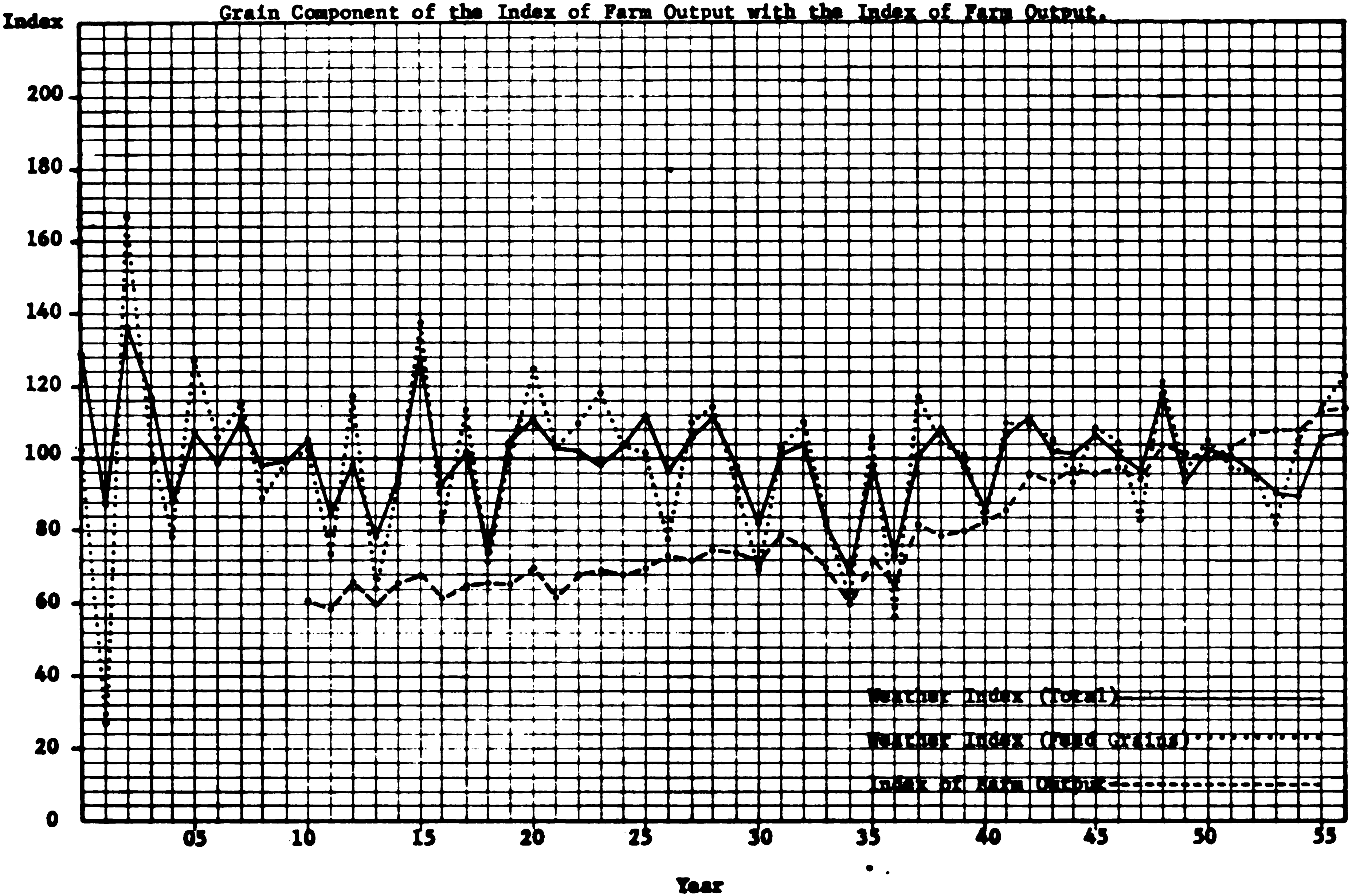


Figure 19: Comparison of the Index of the Influence of Weather on the Index of Farm Marketings and Home Consumption with the Index of Farm Marketings and Home Consumption.

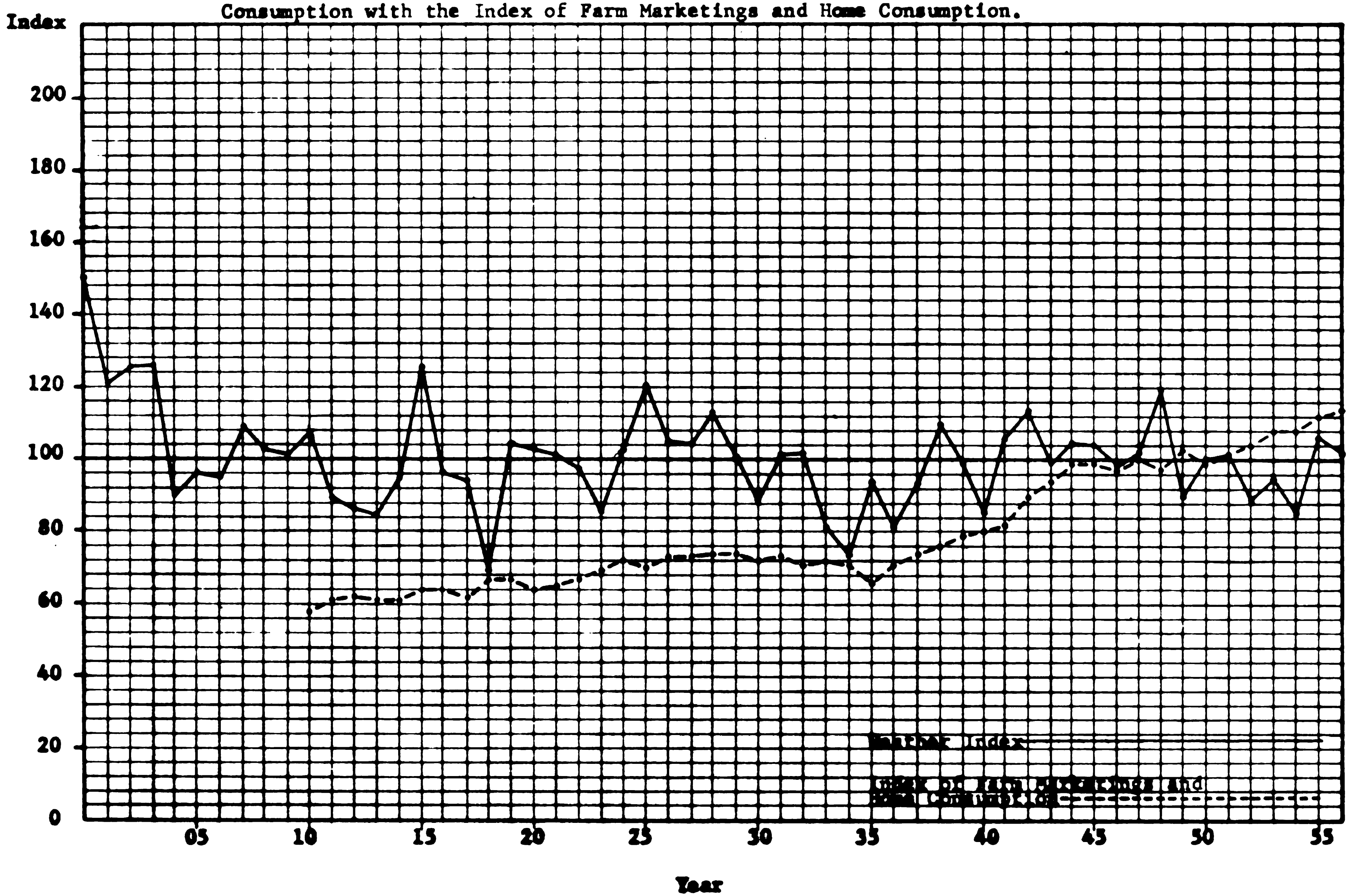


Figure 20: Comparison of the Index of the Influence of Weather on the Feed Grain Component of the Index of Farm Marketings and Home Consumption with the Feed Grain Component of the Index of Farm Marketings and Home Consumption.

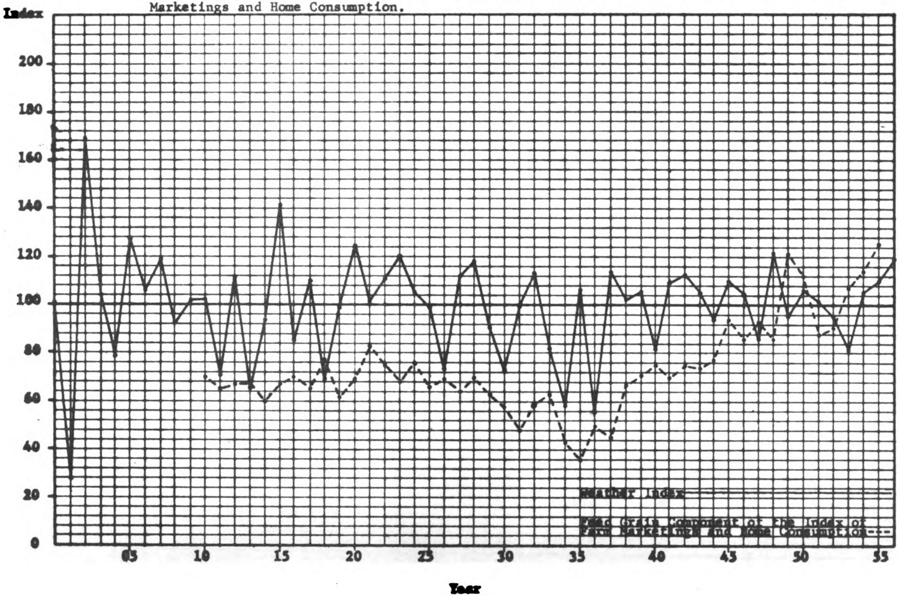
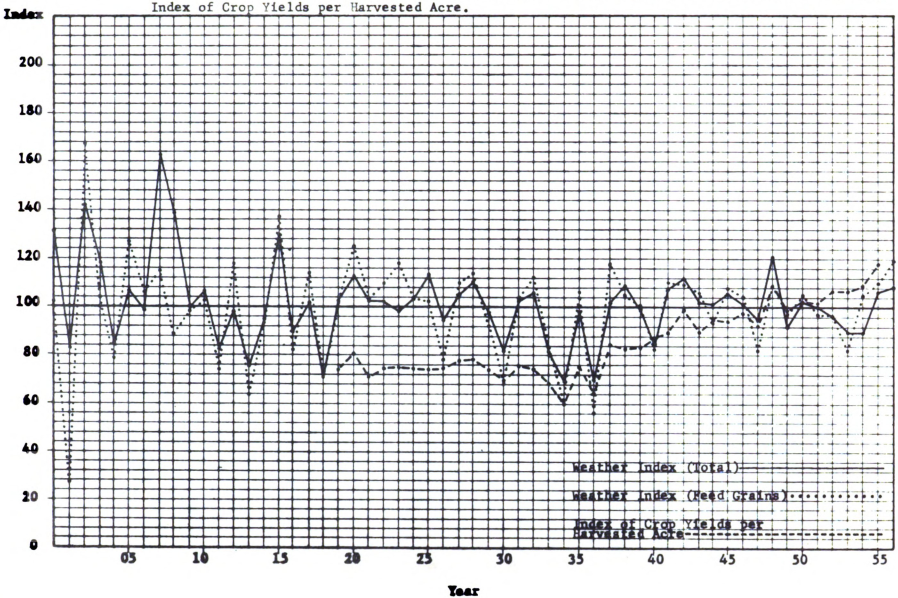


Figure 21: Comparison of the Index of the Influence of Weather on the Index of Crop Yields per Harvested Acre and on the Feed Grain Component of the Index of Crop Yields per Harvested Acre with the Index of Crop Yields per Harvested Acre.



CHAPTER V

EVALUATION

This chapter presents a statistical evaluation of the various weather indexes, discusses sources of error and suggests further study.

Statistical Evaluation

In evaluating the various indexes, special emphasis was given to determining the reliability and usefulness of the indexes in estimating structural relationships. An indication of the reliability and usefulness of each was obtained by computing a regression of deviations about an eleven year moving average of each of the U. S. average yields and aggregate indexes on the corresponding computed weather index. This regression was chosen because it was felt that it was reasonable considering the probable uses of the weather indexes. It was felt that much of the analysis involving the use of these indexes would cover a rather short recent time period. It was assumed that non-weather variables, such as technology, change slowly and that a regression in which an attempt is made to eliminate these variables would be more useful than a more direct one involving the raw data over the longer period covered by the indexes. The parameters of the above mentioned regression and some other statistics are presented in Table 10.

In interpreting Table 10 for both the individual crops and aggregate indexes let:

Y_t = value of a "true" U. S. average yield or aggregate index in period t.

Y_t' = value of a "true" U. S. average yield or aggregate index in period t when weather and non-weather variables not associated with time are "normal." Thus variations in Y_t' in different time periods are due only to non-weather variables associated with time.

$Y_t'' = Y_t - Y_t'$ = variation in a "true" U. S. average yield or aggregate index due to weather variables and non-weather variables not associated with time in period t.

Z_t = value of a "true" index of the influence of weather in period t.

Y_t = value of a published U. S. average yield or aggregate index in period t which is presumably the best available measurement of Y_t.

$Y_t' = 1/11 \sum_{t-5}^{t+5} y_t$ which is presumed to be the best available measurement of Y_t'.

$y_t'' = y_t - y_t'$ which is presumed to be the best available measurement of Y_t''.

TABLE 10: COMPARISON OF THE ESTIMATED PARAMETERS FOR THE REGRESSION OF THE RESIDUALS ABOUT AN ELEVEN-YEAR MOVING AVERAGE OF THE VARIOUS U. S. AVERAGE YIELDS AND AGGREGATE INDEXES ON THE CORRESPONDING COMPUTED WEATHER INDEXES[a]

Dependent Variable -- Residuals about 11-year moving average of:	a	b	R^2
U. S. Average Yields			
Corn (bu./A.)	- 11.93	.12**	.6146
Oats (bu./A.)	- 11.46	.11**	.3780
Barley (bu./A.)	- 2.48	.02**	.2148
Wheat (bu./A.)	- 2.66	.03**	.2215
Soybeans (bu./A.)	- 4.12	.04*	.1781
Cotton (lb./A.)	- 36.60	.36*	.0825
Tobacco (lb./A.)	-131.20	1.27*	.1110
Production Measures			
Index of Crop Production			
All crops	- 28.13	.28**	.4351
Feed grains	- 42.31	.43**	.6133
Index of Gross Farm Production			
All Commodities	- 20.63	.21**	.4372
Index of Farm Output			
All Commodities	- 21.35	.21**	.4036
Index of Farm Marketings and Home Consumption			
All Commodities	- 2.99	.03	.0184
Feed grains	1.48	- .01	.0003
Production Per Unit			
Index of Crop Production per Harvested Acre	- 34.39	.35**	.6811

a a and b are computed for the regression $y_t'' = a + bz_t + u'$ as discussed in this chapter. R^2 is the "coefficient of determination." A "one-tail" test was used to test the hypotheses b = 0 for each b. b's significantly different from 0 at the 1 and 5 percent levels are marked ** and * respectively. Those not marked were considered not significantly different from 0 at an acceptable level of significance.

z_t = value of a computed weather index in period t which is presumed to be the best available measurement of Z_t.

Consider the following relationships:

(1) $Y_t'' = \alpha + \beta Z_t + U$ This is the relationship which would, presumably, give the "true" relationship between weather and U. S. average yields or aggregate indexes.

But Y_t'' and Z_t are not observable. Therefore, consider the relationships:

(2) $Y_t'' = Y_t'' + u_1$ and

(3) $z_t = Z_t + u_2$ in which y_t'' and z_t are observable and u_1 and u_2 are independent normal deviates with means zero and variances $\sigma_{u_1}^2$ and $\sigma_{u_2}^2$. Then the best estimate of Y_t'' is given by the regression of y_t'' on z_t as follows:[1]

(4) $y_t'' = a + bz_t + u'$.

A linear relationship was used because it was felt, upon observation of the plotted points of the Y_t'''s and z_t's that this relationship fitted the data best in most cases.

In order to obtain unbiased estimates of a, b, and R^2 it must be assumed that u' is also independently and normally distributed with mean zero and variance $\sigma_{u'}^2$. To the extent that these assumptions cannot reasonably be made the above

1. For a discussion of this see Winsor, C. P. "Which Regression?" Biometrics, Vol. 2, No. 6, Dec. 1946. See also Goulden, C. H., Methods of Statistical Analysis, Wiley and Sons, New York, 1952, pp. 108-9.

statistics will not provide a very good indication of the reliability and usefulness of the weather indexes. Although it is felt that such assumptions can reasonably be made in this case, some sources of error are discussed in the following section.

Sources of Error

In using equation (4) to derive Table 10 it was assumed that u' was independently and normally distributed with mean zero and variance $\sigma_{u'}^2$ in each case. Contained in u' are deviations due to errors of observation of both Y_t'' and Z_t and due to non-weather variables not associated with time. All contain possible sources of error. Errors of observation for Y_t'' include errors in the published U. S. average yields and aggregate indexes as well as errors due to the methodology used in its computation. Errors of observation for Z_t include errors of observation in the original plot data at each location for each crop as well as errors due to methodology used in its computation. The more important of these latter errors include errors due to:

(1) Choice of time series of yields at particular locations for each crop.

(2) Choice of the method of computing an index for each time series at each location for each crop.

(3) Choice of locations of data for each crop.

(4) Computation of weights for combining indexes at each location into national indexes for each crop.

(5) Computation of weights for combining national indexes for each crop into the various aggregate indexes.

Published U. S. average yields and aggregate indexes were taken as data as was the individual plot yields. It was felt that the necessary assumptions about the errors of observation of these were reasonable considering the fact that the published U. S. average yields and aggregate indexes are adjusted after the actual yields and production is known and considering the nature of the design of crop experiments. The errors which appear to be the greatest are those associated with the methodology involved in computing y_t" and z_t. These are also the errors which should probably receive the greatest attention if further study were carried on in the construction of weather indexes.

Implications of Table 10

The statistics in Table 10 give some indication of the usefulness and reliability of the various weather indexes for use in regression analysis. As for usefulness, persons interested in using these indexes would be particularly interested in the statistic, "R^2". This statistic gives an indication of the percentage of year to year variations in particular dependent variables such as U. S. Average Yields, Production Measures and Production per Unit that are associated with changes in the available weather indexes. For example, by considering the R^2's, one would expect the weather index for corn to be useful and the weather indexes for farm marketings and home consumption to be of little or no use.

As for reliability, an indication of whether or not there is a relationship between a particular weather index and a particular dependent variable can be obtained from the "t-test." The null hypothesis, $b = 0$, was tested and rejected (one-tail test) at the 5 percent level of significance for all but two cases and at the 1 percent level for nine cases.

An indication of how much variation in the particular dependent variable is, on the average, associated with a 1 unit change in the weather indexes can be obtained from the estimates of "b". For instance, in the case of the regression involving U. S. Average Yield of Corn, a 1 unit change in the weather index is, on the average, associated with a .12 bushel change in U. S. Average Yield of Corn and the relationship is positive.

Possibilities for Further Study

In computing y_t' the errors due to moving average construction should be considered. It should be realized, for instance, that a moving average tends to overestimate a "best-fitting" line in some years and underestimate it in others. Another possibility would be to fit some equation such as a polynomial to the data and measure deviations about this. Another possibility for holding non-weather variables due to time constant is to use the method of "first differences." This would eliminate the necessity of fitting either a moving average or some other line to the data. However, two regressions were computed using this method and the results appeared to have no advantage over the method used.

The method of adjusting the original time series with a linear trend in computing the individual weather indexes could be further studied. Other methods than using experimental plot data could also be explored. Although it was found that combining measurements of the various components of weather such as rainfall, sunlight and temperature into a weather index become rather complicated, it might prove to be a reliable method with further study.

The possibilities of bias due to using plots with treatments atypical of the area to be represented in some cases could be further studied. Plots involving atypical treatments may be used if it can be assumed that there is no sizeable weather-treatment interaction. To be useful, data need only be representative in the sense of accurately reflecting weather effects. Past studies contain some information on this matter. A limited review of the literature on selected crops indicate that, in some cases, there is a significant relationship between certain factors and variability in yields due to weather. A specific example of this is the interaction between fertilizer application and/or inherent fertility of the soil and variability in yields due to weather.[1] Except in special cases, variability in yields appeared to be inversely related to fertilizer applications and/or inherent fertility level of the soils, up to certain levels, beyond which variability again increased. The implication of this would be that there may be more or less important sources of error due to not using data which best approximate fertilizer application or fertility conditions in the area to be represented by the data. Other literature indicated that there may be significant interrelationship between such things as tillage methods, variety, etc. and variability in yields due to weather.[2] Several plots involving atypical treatment were used in this study. In many cases they were the only series available. In other

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1. For one illustration of this see Fulmer, J. L. and R. R. Botts, op. cit., p. 7. See also Miller, L. B. and F. C. Bauer, "The Effect of Soil Treatment in Stabilizing Yields of Corn," Jour. Am. Soc. Agron., Vol. 30, N. 8, August, 1938.

2. See Miller, J. D. and W. W. Ross, "Relative Yields of Varieties of Wheat on Fallow and on Cropland at Hays, Kans., 1921-52," Agronomy Journal, Vol. 47, No. 7, July, 1955.

cases atypical series were used when it was felt that their advantages out-weighed their possible disadvantages. Some of these advantages included the fact that longer series were sometimes available for atypical treatments. It was assumed, however, that individual errors due to atypical treatments were themselves, independently and normally distributed with an expected value of zero. This assumption seems feasible when it is considered that a large number of individual series were used.

Another source of further study could be on the results of not including series for various locations for the individual crop weather indexes and of not including many crops in the various aggregate weather indexes. In this study data were collected until it was felt that the added returns in accuracy from collecting more data was no longer worth the extra cost. Aggregate indexes, however, were made up of the available individual indexes and no further accuracy was possible. It appeared to be a reasonable assumption for this study that the errors due to these sources also meet the assumptions required in the regression used.

The choice of weights and base periods are two more sources of error which could be further studied. It is possible that there may be biases in some indexes due to using a relatively recent base period as the source of weights; but, it is felt that these become relatively unimportant in years near the base period. Since these are the more recent years and ones which will probably be used the most, it was felt that it was not worth the extra trouble to either attempt another method of weighing or to use more than one base period in this study.

In view of the possible usefulness of weather indexes of the nature computed in this study, it is felt that it would also be highly desirable for some agency to further test and improve their accuracy. This would include a study of the sources of bias and error mentioned above. It would also be desirable to have some method of keeping the indexes current from year to year. The above suggestions would involve extracting some data known to exist which were unavailable for this study. It would also involve locating new data. After data for past years have been obtained, it should be a less costly matter to arrange with various sources to obtain yield data in future years as it becomes available. Procedures could be worked out for incorporating new data into these indexes as it becomes available. The U.S.D.A. appears to be a reasonable choice for doing such research. Possibly, the indexes could be published and kept current in such publications as Agricultural Statistics along with the indexes of pasture and range conditions which are already maintained.

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Other references used as a source of raw data are included in the "Sources of Data" section of Appendix A.

APPENDIX A

BASIC TIME SERIES USED IN ANALYSIS

CORN RAW DATA

YEAR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1900									28.6
1901									11.3
1902									79.4
1903	39.7	37.2							55.5
1904	58.9	48.4	17.1						13.4
1905	68.8	51.9	31.4						64.2
1906	42.4	57.4	35.8						-
1907	64.9	46.0	48.7						33.4
1908	68.7	31.3	28.0						11.7
1909	65.4	62.2	31.6						16.6
1910	76.0	66.5	54.6						6.5
1911	45.7	29.5	31.5						25.1
1912	72.1	72.1	64.2						30.8
1913	44.9	39.2	32.0						19.2
1914	50.0	46.8	39.4						33.9
1915	54.4	62.1	66.0						45.7
1916	42.5	37.2	10.8						14.6
1917	65.8	69.0	67.0						35.6
1918	55.2	60.0	32.6						22.4
1919	46.0	57.3	43.4	46.1	62.5	66.6	50.1	44.6	39.1
1920	74.1	66.1	54.4	48.7	57.0	70.6	57.0	52.9	50.8
1921	67.0	60.2	42.2	41.8	55.6	57.0	50.2	43.3	42.8
1922	59.9	47.7	38.9	46.1	55.6	59.7	52.9	40.5	45.0
1923	66.4	58.2	31.4	37.8	58.2	59.4	51.0	43.8	42.6
1924	51.4	46.3	38.0	36.4	43.3	41.9	37.8	30.9	37.8
1925	59.7	58.2	45.4	57.6	60.2	64.0	52.5	33.3	34.0
1926	69.1	57.6	35.4	40.2	40.2	42.6	36.6	25.8	19.8
1927	78.3	80.6	41.0	41.0	42.3	44.8	39.7	33.9	24.2
1928	62.1	42.8	32.4	54.7	55.6	52.0	42.6	36.6	35.6
1929	69.0	52.0	36.0	47.0	51.9	52.4	43.8	38.2	7.8
1930	36.3	39.8	31.1	33.9	34.9	38.7	36.8	36.0	4.0
1931	49.4	62.7	49.2	43.4	52.7	71.1	42.7	37.5	50.0
1932	63.8	62.0	54.0	51.7	57.0	55.8	48.0	39.4	38.3
1933	44.2	16.5	27.9	51.5	56.3	54.6	43.2	34.8	32.4
1934	53.5	58.2	51.0	25.1	25.7	24.2	25.3	22.4	-
1935	72.8	70.8	62.9	59.5	65.7	69.2	68.0	47.8	17.8
1936	17.0	30.0	16.6	26.6	27.5	30.4	29.1	23.4	-
1937	80.1	79.6	60.8	74.1	79.7	78.1	75.0	53.7	42.7
1938	89.6	73.3	62.3	47.5	55.6	58.6	50.2	29.7	44.8
1939	85.0	56.6	50.3	60.0	63.4	66.5	55.0	48.5	
1940	71.8	51.4	43.7	46.6	54.7	57.2	48.9	41.7	
1941	115.6	96.7	63.1	52.3	63.4	66.9	57.3	43.6	
1942	103.2	94.0	61.3	50.2	64.4	55.8	53.3	52.5	
1943	89.4	60.0	59.5	45.9	55.8	55.2	51.2	42.5	
1944	84.0	79.8	62.2	42.5	46.6	48.1	46.7	36.3	
1945	91.2	75.9	70.7	39.6	55.2	55.1	42.6	32.0	
1946	100.4	78.2	84.7	33.2	48.0	55.1	51.2	37.4	
1947	72.9	62.3	37.9	27.6	19.0	23.4	24.8	23.4	
1948	113.7	110.9	74.7	56.8	60.0	64.0	56.6	40.0	
1949	100.9	86.0	63.8	37.2	46.5	47.6	36.8	27.5	
1950	93.5	90.4	50.8	39.5	55.8	60.8	48.3	30.9	
1951	102.4	85.4	65.3	26.8	38.1	37.7	29.4	22.3	
1952	81.0	85.6	52.5						
1953	91.6	72.9	53.2						
1954	83.7	82.4	72.0						
1955	87.4	84.2	78.8						
1956	79.8	85.7	98.0						

YEAR	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1900									
1901									
1902	75								
1903	75								
1904	62								
1905	72								
1906	66								
1907	66								
1908	55								
1909	41								
1910	58								
1911	43								
1912	48								
1913	8								
1914	53								
1915	75								
1916	62								
1917	47								
1918	3								
1919	21								
1920	54								
1921	65								50.4
1922	47								41.1
1923	61								46.3
1924	39								27.5
1925	38								3.7
1926	3								40.4
1927	66								44.3
1928	38								37.9
1929	55								36.8
1930	9								8.4
1931	30								22.8
1932	47								45.9
1933	38								0
1934	0								0
1935	7								7.0
1936	0								0
1937	5								
1938	4								
1939	4								
1940	18								
1941	13								
1942	37	46.8	51.0	43.9	38.2	39.6	48.4	39.9	
1943	56	56.9	71.1	56.0	62.4	50.8	53.3	52.4	
1944	57	77.3	75.0	71.2	66.0	66.5	62.8	57.9	
1945	54	65.4	66.1	56.2	52.2	44.6	46.1	53.9	
1946	54	82.0	81.6	77.1	71.8	51.5	49.0	61.1	
1947	21	26.8	30.0	25.5	27.3	13.3	19.7	23.0	
1948	73	75.6	89.6	66.4	80.0	54.6	61.6	69.2	
1949		72.7	69.4	72.2	68.4	45.4	38.4	59.3	
1950		120.8	113.2	96.0	98.0	61.9	73.2	74.6	
1951		79.4	70.0	69.6	51.7	28.8	40.8	35.7	
1952									
1953									
1954									
1955									
1956									

YEAR	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
1900									
1901									
1902									
1903									
1904									
1905									
1906									
1907	20.2								
1908	26.1								
1909	26.4								
1910	5.3								
1911	.6								
1912	25.5								
1913	0								
1914	4.7								
1915	24.0								
1916	9.7								
1917	9.0								
1918	22.0								
1919	34.1								
1920	38.2								
1921	20.1								
1922	31.9								
1923	50.4								
1924	21.8								
1925	8.4								
1926	2.0								
1927	47.3								
1928	32.8								
1929	14.1								
1930	29.6								
1931	14.1								
1932	7.5								
1933	24.0								
1934	0								
1935									
1936		4.5	4.6	9.1	10.3	8.8	6.5	4.5	3.9
1937		0	7.5	0	0	0	0	0	0
1938		8.5	16.7	12.5	12.5	12.6	4.9	4.5	3.9
1939		.1	13.6	15.0	9.0	9.5	3.9	3.8	1.0
1940		0	28.0	0	0	0	2.4	0	0
1941		28.8	40.8	38.8	35.8	32.8	27.9	20.9	21.9
1942		4.6	5.8	7.3	7.9	6.6	7.4	5.0	6.3
1943		29.6	23.5	33.3	34.4	31.6	33.9	28.7	33.6
1944		28.5	41.3	35.2	40.4	33.5	30.4	32.9	37.0
1945		37.2	34.5	27.7	30.7	32.1	27.7	28.8	29.3
1946		22.3	19.0	12.4	14.4	13.0	15.4	14.7	26.4
1947		27.0	24.8	24.1	29.6	26.8	24.2	27.6	27.2
1948		21.0	38.8	20.3	25.0	24.6	23.3	24.8	26.4
1949		37.7	34.6	26.7	33.3	28.2	36.5	30.7	35.0
1950		25.7	36.5	16.9	20.3	18.2	39.9	30.7	37.0
1951							34.1	27.5	30.0
1952								23.0	26.0
1953								3.4	9.9
1954								20.5	30.4
1955								0	0
1956									

YEAR	(28)	(29)
1900		
1901		
1902		
1903		
1904		
1905		
1906		
1907		
1908		
1909		
1910		
1911		
1912		
1913		
1914		
1915		71
1916		58
1917		71
1918		53
1919		91
1920		64
1921		66
1922		65
1923		66
1924		77
1925		109
1926		79
1927		74
1928		99
1929		81
1930		22
1931		65
1932		58
1933		52
1934		77
1935		91
1936	3.2	70
1937	0	70
1938	5.8	78
1939	1.0	63
1940	3.0	65
1941	31.0	72
1942	8.4	65
1943	35.4	75
1944	40.0	29
1945	33.2	56
1946	31.4	51
1947	22.9	57
1948	25.8	63
1949	33.3	93
1950	36.8	82
1951	35.4	89
1952	18.7	111
1953	13.4	70
1954	43.0	
1955	7.6	
1956		

OATS RAW DATA

YEAR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1900				24.8	49.8				
1901				1.1	2.0				
1902				20.8	15.1				
1903				-	-				
1904	25.1			7.3	31.3				
1905	59.2			7.3	19.1		83.3		
1906	58.5			17.1	34.1		40.9		
1907	35.2			21.9	37.4		46.7		
1908	29.0			10.2	29.1		61.1		
1909	43.1			12.2	15.8		73.0		
1910	56.3			9.0	29.7		51.8		
1911	70.7			5.0	26.1		39.7		
1912	78.8			29.3	32.4		37.2		
1913	27.5			3.9	9.6		55.5		
1914	51.0			4.1	5.3		72.6		
1915	81.1	32.8	39.4	30.6	35.8		54.0		
1916	64.8	43.7	46.3	29.0	30.2		60.0		
1917	62.0	41.2	79.4	53.7	65.1	94.5	88.3		
1918	61.8	33.7	43.7	19.9	36.1	6.0	12.6		
1919	37.2	40.0	40.7	25.6	26.0	34.2	-		
1920	40.6	43.8	78.8	15.3	46.4	65.0	55.7		
1921	39.1	50.0	37.5	42.0	46.8	59.2	41.0	37.7	
1922	49.3	40.6	49.4	10.9	24.2	19.3	31.2	38.4	
1923	58.7	38.1	63.1	21.9	63.0	67.7	68.2	53.3	
1924	71.0	44.4	68.8	24.5	46.6	49.6	42.1	37.5	
1925	43.8	31.2	30.0	21.4	58.8	29.1	27.9	19.7	
1926	77.2	22.2	53.1	28.2	51.6	7.4	10.3	55.3	
1927	61.6	37.8	44.7	34.8	48.1	49.7	45.6	61.5	
1928	61.6	42.5	38.1	32.8	67.8	49.6	43.8	48.5	
1929	66.9	33.8	76.8	17.9	45.1	63.0	64.2	62.8	
1930	58.6	37.5	50.0	16.1	29.4	52.2	73.1	60.3	
1931	59.6	41.3	40.0	34.5	51.8	58.4		53.9	
1932	73.1	43.1	68.8	9.6	32.8	53.4		41.4	
1933	42.8	37.8	30.6	20.6	49.4	0		0	
1934	13.1	10.1	24.6	3.1	7.0	0		0	
1935	64.5	54.4	45.0	33.4	33.6	32.3		56.0	
1936	51.4	34.4	50.0	7.7	32.4	9.4		20.9	
1937	69.1	66.3	66.9	60.6	51.6	41.0			
1938	48.1	28.8	36.9	10.5	23.0	45.0			
1939	41.3	34.4	29.4			25.7			
1940	74.7	23.8	37.5			11.2			
1941	54.2	37.5	58.8			39.7			
1942	45.8	37.5	60.0			45.3			55.0
1943	49.2	41.2	53.8			70.2			74.8
1944	39.1	11.9	27.5			46.0			27.4
1945	75.0	36.9	57.5			47.1			56.9
1946	70.3	23.8	34.4			22.1			29.0
1947	95.1	18.8	71.2			84.6			39.0
1948	75.9	33.8	56.2			68.6			65.0
1949	39.6	16.9	37.5			30.9			29.1
1950	44.9	23.1	53.4			65.0			62.3
1951	38.5	19.4	40.0						49.1
1952	54.1								
1953									
1954									
1955									

OATS RAW DATA

YEAR	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1900									
1901									
1902									
1903									
1904									
1905									
1906									
1907			31.4						
1908			61.1						
1909			26.0						
1910			13.3						
1911			0						
1912			12.8						
1913			0						
1914			8.7						
1915			64.3						
1916			42.0						
1917			9.7						
1918			8.5						
1919			39.5						
1920			39.9						
1921			22.7						
1922			16.5						
1923			56.6						
1924			51.3						
1925			18.7						
1926			2.7						
1927			39.4						
1928			55.6						
1929			33.2						
1930			59.7						
1931			33.8						
1932			16.8						
1933			21.7						
1934			.9						
1935									
1936				12.5	16.3	19.1	16.6	0	20.3
1937				26.9	7.5	3.8	4.1	4.1	32.8
1938				21.9	32.8	34.1	27.5	26.9	37.8
1939				45.3	30.0	26.6	18.8	28.8	39.4
1940				0	0	0	0	0	0
1941				57.8	45.3	40.0	45.3	40.6	60.0
1942	46.1	52.1		33.1	27.2	40.9	27.5	26.9	33.8
1943	59.1	62.2		0	0	0	0	0	0
1944	23.3	32.1		55.6	38.1	37.2	38.1	35.0	48.1
1945	45.0	41.9		68.4	29.4	29.7	35.9	33.4	73.4
1946	23.6	22.3		61.9	24.1	38.8	28.4	29.7	70.3
1947	30.7	26.9		54.4	24.1	32.5	34.7	36.3	56.6
1948	43.9	35.3		32.2	24.1	21.9	25.6	21.3	43.8
1949	22.1	22.7						27.8	40.9
1950	42.9	35.6						7.5	17.2
1951	32.8	30.9							
1952									
1953									
1954									
1955									
1956									

OATS RAW DATA

YEAR	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
1900								
1901								
1902								
1903								
1904								
1905								
1906								
1907		54.5	49.4					
1908		61.9	48.4					
1909		66.6	55.9					
1910		50.6	32.0					
1911		26.1	6.6					
1912		0	0					
1913		60.0	33.0					
1914		41.4	15.3	39.0	42.9	41.6	33.5	40.2
1915		92.2	55.6	95.3	97.0	96.6	96.4	97.2
1916		81.2	41.3	63.3	65.5	74.4	70.9	71.4
1917		27.5	7.2	45.2	49.2	43.0	50.0	60.0
1918		21.3	0.9	10.8	9.8	11.0	10.3	9.4
1919		1.7	0	29.4	31.1	29.8	34.8	36.1
1920		40.9	38.7	67.3	75.9	78.0	79.3	70.5
1921		16.9	0	37.3	39.4	40.6	42.3	48.4
1922		73.0	69.4	62.1	70.8	72.5	73.8	77.7
1923		66.9	38.8	56.2	58.4	60.5	61.1	61.4
1924		81.9	49.4	81.6	76.6	89.5	95.1	71.3
1925		46.3	16.6	76.4	75.1	75.1	83.4	80.6
1926		28.1	0	59.0	60.2	59.7	63.8	65.7
1927		54.4	44.4	64.2	60.5	68.2	64.5	66.5
1928		95.6	38.4	72.3	73.6	74.7	64.9	63.9
1929		29.7	21.3	53.1	58.1	73.0	79.7	73.3
1930		50.6	18.8	73.5	78.0	82.6	84.6	87.3
1931		6.3	0	28.3	30.3	30.9	29.7	28.5
1932		54.7	29.7	68.0	68.1	72.6	74.1	65.9
1933		34.7	8.1	27.5	25.8	26.3	26.8	26.5
1934		28.4	10.0	37.7	39.1	42.4	44.5	46.9
1935		18.1	31.6	79.0	81.2	84.0	83.3	83.0
1936	19.4	0	0	8.9	9.0	10.5	11.6	8.2
1937	19.1	4.7	5.9	52.7	43.3	45.1	41.8	57.5
1938	34.4	22.2	10.0	74.6	70.5	65.9	66.3	71.3
1939	33.8	63.1	58.1	60.0	58.0	62.4	61.3	59.8
1940	0	44.4	13.4	60.0	61.7	55.8	59.6	61.3
1941	48.4	20.9	15.0	51.0	56.6	57.8	58.5	57.2
1942	35.0	74.1	58.1	81.0	87.4	84.2	84.2	75.9
1943	0	51.6	48.4	94.4	102.2	102.0	92.0	93.6
1944	54.7	88.8	51.6	81.6	84.1	82.0	81.6	76.3
1945	65.6	59.7	31.9	76.4	81.7	92.8	96.2	102.1
1946	58.8	71.9	20.3	94.9	98.6	103.4	105.3	103.0
1947	58.1	64.7	37.2	67.0	76.7	85.5	83.8	85.0
1948	49.4	62.2	31.6	75.4	80.3	82.7	83.4	77.8
1949	39.4	23.4	13.8	88.5	89.8	93.5	95.3	96.7
1950	15.0	53.8	30.6	66.1	62.8	70.0	70.2	74.2
1951		60.6	33.8	94.5	109.2	98.0	103.8	106.8
1952		29.4	16.9	50.0	57.1	65.8	71.4	66.9
1953				62.4	68.6	70.1	72.5	74.9
1954								
1955								
1956								

BARLEY AND SOYBEANS RAW DATA

YEAR	(1)	(2)	(3)	(4)	(5)	(6)
1900						
1901						
1902						
1903						
1904						
1905						
1906						
1907			37.7	37.3	45.8	
1908			35.5	30.0	33.5	
1909			19.1	50.0	39.8	23.4
1910			15.2	24.0	28.3	24.6
1911			0	19.1	9.6	23.4
1912		20	17.5	0	0	17.9
1913		17	7.8	36.9	19.2	15.2
1914		21	9.2	35.2	25.0	19.3
1915		40	37.2	64.4	49.0	20.1
1916		40	30.7	38.8	23.6	10.8
1917		35	16.8	10.8	8.1	17.7
1918		21	10.2	3.8	2.9	16.1
1919		44	34.1	0.6	1.3	20.0
1920		30	24.1	25.6	31.5	19.0
1921		36	20.2	6.9	7.6	32.1
1922		12	10.5	44.3	38.7	19.6
1923		46	33.3	35.0	24.8	13.3
1924		48	27.8	29.6	21.9	16.6
1925		28	12.3	12.3	9.0	32.2
1926		9	1.0	7.1	0	29.3
1927		37	33.9	33.8	23.3	26.2
1928		60	39.5	52.1	18.1	35.7
1929		46	23.6	11.7	7.1	35.9
1930		44	35.3	23.5	21.9	26.2
1931		26	20.1	4.2	0.6	29.4
1932		29	6.3	47.7	22.9	40.0
1933		23	14.9	16.5	4.6	31.8
1934		3	.2	14.2	3.8	26.2
1935		-		19.2	25.0	30.5
1936		-		0	0	35.4
1937		25		6.0	11.9	25.6
1938		18		18.3	8.5	39.8
1939		33		38.8	40.0	28.7
1940		0		26.7	19.0	26.0
1941	43.7	39		13.8	9.4	38.2
1942	25.5			48.5	34.4	32.7
1943	14.4			27.3	24.0	27.9
1944	5.7			40.2	19.2	35.0
1945	70.3			24.0	15.4	29.3
1946	45.5			27.3	9.8	28.0
1947	58.1			28.1	21.5	18.2
1948	35.0			33.8	22.3	35.6
1949	44.8			5.8	7.7	34.9
1950	-			25.4	19.4	31.7
1951	35.0			38.5	28.1	36.7
1952	27.7			18.1	12.6	34.4
1953	19.2					27.9
1954						32.5
1955						27.4
1956						42.6
1957						37.5

WHEAT RAW DATA

YEAR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1900									
1901									
1902									
1903									
1904			19.0						
1905			30.7						
1906			38.1						
1907			42.9						
1908			42.6						
1909			41.6			0	0	0	
1910		14.1	47.1			6.2	7.5	7.5	
1911		4.1	51.8			0	0	0	
1912		33.8	-			0	0	0	
1913		7.4	36.8			-	-	-	
1914		25.5	38.2	10.0		8.5	11.6	14.5	
1915		21.8	50.2	19.5	16.0	10.7	20.1	21.6	
1916	13.7	13.7	40.6	26.0	18.0	0	5.9	6.2	
1917	6.6	6.6	43.9	0	0	0	0	0	
1918	5.3	5.3	31.6	8.3	8.0	0	.5	0	
1919	15.0	15.0	32.8	13.7	16.0	20.0	24.0	19.8	26.0
1920	14.2	14.2	44.0	31.7	22.3	3.9	6.7	7.2	6.0
1921	12.3	12.3	34.4	25.2	-	6.2	14.6	11.2	20.0
1922	.6	.6	36.4	18.2	15.0	0	0	0	-
1923	3.2	3.2	34.2	1.8	5.7	-	-	2.3	2.2
1924	3.9	3.9	38.7	31.8	17.3	18.9	25.1	23.0	26.3
1925	6.5	6.5	45.4	27.8	13.0	.6	17.5	12.5	24.7
1926	1.3	1.3	43.3	13.3	5.3	2.4	6.7	3.3	13.0
1927	16.3	16.3	34.3	3.0	2.0	0	0	0	0
1928	11.7	11.7	-	37.9	25.3	-	-	-	-
1929	4.0	4.0	36.3	14.3	8.3	16.5	30.6	26.2	32.9
1930	12.3	12.3	43.3	42.8	33.0	12.0	32.8	27.5	45.0
1931	7.3	7.3	47.5	23.3	12.7	23.9	33.2	31.7	35.2
1932	2.2	2.2	32.6	36.8	14.3	5.1	29.9	28.0	
1933	1.0	1.0	26.8	0	0	0	5.0	6.8	
1934	1.9	1.9	18.6	5.5	2.0	0	2.9	2.5	
1935	6.2	6.2	26.3	0		0	0	0	
1936	17.0	17.0	38.7						
1937	11.0	11.0	7.3						
1938	12.2	12.2	43.9						
1939			32.2						
1940			30.9						
1941			27.6						
1942			26.6						
1943			34.8						
1944			26.4						
1945			36.4						
1946			36.5						
1947			48.3						
1948			46.9						
1949			38.1						
1950			47.2						
1951			31.6						
1952			33.0						
1953			52.3						
1954									
1955									
1956									

YEAR	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1900									21.5
1901									25.2
1902									27.1
1903									16.0
1904									-
1905									15.4
1906									8.7
1907									10.8
1908									16.1
1909									15.2
1910					27.8	31.2			6.2
1911					2.2	.3			10.3
1912					17.0	15.7			12.5
1913					8.4	3.9			16.9
1914					25.8	23.4			26.4
1915					17.0	12.8			18.7
1916					37.0	20.5			10.7
1917					6.9	1.2			10.9
1918					18.1	16.0			30.3
1919	22.5	19.5	17.3	21.0	12.6	18.4			12.0
1920	8.8	6.7	0	0	36.6	23.6			25.1
1921	6.2	5.8	3.8	8.8	39.2	22.3			16.9
1922	-	-	-	-	29.0	9.7	22.0	22.4	24.2
1923	4.8	0	0	0	-	-	-	-	24.1
1924	23.2	17.3	14.0	21.0	47.9	39.0	32.1	24.4	24.5
1925	2.5	0	0	0	20.6	1.6	6.2	7.7	31.3
1926	3.8	2.8	1.2	1.7	21.8	13.6	14.7	14.9	13.7
1927	0	0	0	0	14.5	5.8	4.1	4.3	26.4
1928	-	-	-	-	49.7	38.4	33.1	29.2	15.5
1929	16.7	18.0	12.6	18.8	20.9	20.5	22.9	20.5	25.4
1930	12.3	12.8	8.2	14.5	32.5	22.8	28.6	22.4	12.2
1931	23.2	24.3	21.8	26.2	37.6	25.2	20.8	19.9	25.2
1932					47.1	28.3	29.2	25.3	12.4
1933					20.5	12.7	10.4	10.8	30.2
1934					18.9	0	2.4	5.1	20.1
1935					1.1	0	-	-	15.0
1936							17.7	13.9	10.4
1937							6.2	6.7	19.0
1938							15.4	16.0	19.0
1939							0.8	0.8	
1940							6.2	8.2	
1941							20.3	18.9	
1942							5.8	8.9	
1943							6.3	6.3	
1944							23.3	23.7	
1945							7.5	4.3	
1946							14.8	12.3	
1947							31.7	23.2	
1948							20.6	18.5	
1949							2.9	0.0	
1950							9.3	9.8	
1951							23.0	20.5	
1952							22.0	20.3	
1953							2.7	3.1	
1954									
1955									

YEAR	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
1900	19.3	17.3	10.0	16.7	10.5	19.3	23.5		
1901	23.3	28.7	27.2	28.5	21.0	23.6	24.1		
1902	35.2	26.6	11.7	25.8	31.5	30.1	32.6		
1903	17.3	18.7	-	7.4	10.8	7.5	6.8		
1904	-	-	-	-	-	-	-		
1905	12.4	7.9	-	29.7	19.3	15.6	15.6		
1906	7.2	33.4	8.7	11.3	8.0	11.8	7.2		
1907	17.1	27.9	24.8	11.4	9.5	23.1	24.1		
1908	14.5	14.1	16.1	19.1	16.4	24.8	23.9		
1909	-	23.0	21.9	10.4	10.4	13.8	11.7		
1910	12.7	-	-	-	-	-	-		
1911	6.5	16.5	20.2	18.4	19.7	28.6	30.6		
1912	12.6	7.7	10.0	12.0	11.4	10.7	12.1		
1913	15.9	17.0	20.9	22.5	16.8	17.3	17.4		
1914	26.6	20.3	29.4	28.2	29.6	30.6	28.4		
1915	14.2	-	17.8	14.2	8.4	18.4	22.2		
1916	8.8	10.5	15.2	11.6	10.8	10.5	7.8		
1917	8.3	6.5	8.6	10.2	8.6	9.3	14.9		
1918	35.2	34.3	33.8	26.2	19.5	27.9	34.4		
1919	13.5	11.1	12.8	11.8	5.7	12.8	18.3		
1920	19.8	4.2	27.8	29.5	11.7	19.1	28.0		
1921	12.6	12.8	15.2	14.7	3.6	23.0	26.7	27.6	36.8
1922	26.7	23.3	15.0	20.0	21.0	21.9	27.3	23.5	31.1
1923	29.2	32.4	25.3	24.4	13.0	25.6	32.8	21.8	23.7
1924	14.2	25.7	21.6	19.5	10.2	18.1	26.1	55.3	37.9
1925	34.3	39.1	29.6	31.7	33.4	26.4	29.6	13.5	12.9
1926	13.7	21.6	12.5	9.7	3.7	5.1	11.7	12.5	17.5
1927	24.0	21.8	22.5	22.0	8.3	18.2	23.0	22.0	44.8
1928	12.8	25.6	20.4	14.8	13.2	8.5	19.9	25.5	19.8
1929	21.6	19.0	12.5	24.3	19.6	9.1	7.0	41.6	48.3
1930	10.2	21.6	1.4	2.4	3.2	1.1	4.4	34.9	37.5
1931	28.1	25.9	15.6	25.7	32.9	25.1	28.4	39.8	43.0
1932	9.0	23.3	12.6	5.4	1.2	12.6	19.1	27.1	8.3
1933	22.6	26.8	29.7	22.1	12.0	20.2	33.4	16.8	25.0
1934	9.3	23.3	22.2	7.9	2.6	11.9	24.5	25.3	34.8
1935	17.8	11.2	15.2	20.8	11.3	12.6	19.0	23.3	22.6
1936	12.8	30.9	12.4	11.2	2.7	4.3	8.2	24.7	29.2
1937	22.5	15.5	24.2	24.6	16.8	16.7	22.2	15.4	15.1
1938	19.3	14.4	15.6	18.2	9.5	16.3	16.1	10.1	22.3
1939								11.1	10.5
1940								21.1	20.7
1941								0	17.0
1942								39.6	43.3
1943								36.9	40.1
1944								22.5	24.5
1945									
1946									
1947									
1948									
1949									
1950									
1951									
1952									
1953									
1954									
1955									

YEAR	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
1900									
1901									
1902									
1903									
1904									
1905									
1906									
1907									
1908									
1909									
1910									
1911									
1912						7.2	7.7	10.7	
1913						3.2	3.8	14.4	
1914						3.3	4.7	7.6	
1915						39.7	39.8	35.6	
1916						23.5	28.3	30.7	
1917						0	0	0	
1918						0	0	6.7	
1919						19.8	18.3	21.9	
1920						21.2	31.2	28.3	
1921	32.1	41.5				18.5	19.8	22.9	
1922	27.3	41.7				4.8	11.2	13.1	
1923	25.3	20.3				0	17.8	9.8	9.5
1924	64.5	45.7				16.3	53.8	32.4	10.1
1925	12.6	13.6				7.2	6.0	10.6	3.0
1926	21.1	16.6				0	0	4.0	0
1927	38.5	36.2				5.7	20.8	19.3	7.4
1928	19.1	21.7				31.0	35.0	35.6	22.7
1929	48.6	40.6				12.3	16.2	16.9	10.3
1930	37.5	31.3				36.7	38.2	42.3	32.6
1931	47.3	41.5				22.5	23.2	33.1	22.1
1932	24.7	20.2				0	0	.2	0
1933	23.9	18.7				0	12.2	9.7	0
1934	30.9	21.8				0	0	2.4	0
1935	22.7	8.4							
1936	27.5	30.9							
1937	14.7								
1938	18.3								
1939	12.4								
1940	17.4								
1941	10.1								
1942	41.4		52.8	46.8	45.8				
1943	43.3		54.1	45.3	45.5				
1944	24.7		42.6	34.6	33.2				
1945			52.2	49.8	42.9				
1946			42.9	29.7	26.5				
1947			43.9	35.5	36.8				
1948			41.5	31.9	24.3				
1949			40.0	35.1	29.1				
1950			49.7	39.6	26.2				
1951			30.2	24.8	18.8				
1952									
1953									
1954									
1955									
1956									

WHEAT RAW DATA

YEAR	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)
1900									
1901									
1902									
1903									
1904									
1905									
1906									
1907									
1908									
1909									
1910									
1911									
1912									
1913									
1914									
1915									
1916									
1917									
1918									
1919									
1920									
1921									
1922									
1923	14.9								
1924	39.1								
1925	4.2								
1926	0								
1927	18.3								
1928	29.5								
1929	14.4								
1930	39.7								
1931	23.7								
1932	0								
1933	10.9								
1934	0								
1935									
1936		17.7	27.0	26.0	10.8	11.1	17.0	22.0	22.0
1937		7.1	2.5	8.2	6.1	6.0	0	0	0
1938		9.8	5.6	12.4	9.9	15.0	23.0	12.5	13.5
1939		13.6	20.1	22.9	13.9	18.6	33.7	19.5	22.7
1940		0	0	1.4	0	11.8	13.7	0	0
1941		14.8	13.9	16.0	14.1	19.8	21.8	15.5	11.7
1942		49.0	42.6	40.7	49.2	40.2	36.7	28.0	39.3
1943		0	0	0	0	0	0	0	0
1944		5.8	6.7	8.6	6.0	25.5	24.8	10.2	9.2
1945		8.4	4.4	47.0	6.7	48.8	55.0	10.2	4.0
1946		22.1	12.0	45.8	19.6	34.2	44.7	12.7	16.5
1947		18.5	23.3	46.5	28.7	46.5	50.8	26.0	26.7
1948		11.7	10.7	37.4	11.5	39.8	42.8	16.5	17.0
1949		2.0	1.0	13.7	3.6	21.2	18.5	6.2	9.2
1950		8.9	7.9	30.7	11.1	25.8	29.7	15.0	14.2
1951		5.5	5.5	15.9	6.4	28.6	7.7	10.8	10.7
1952			9.1	24.0	7.6	35.6			
1953			5.2	19.5	7.4	29.0			
1954			4.8	12.8	9.5	21.0			
1955			17.3	43.0	15.3	46.6			
1956									

YEAR	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)
1900									
1901							32.5	27.0	
1902							28.7	23.1	
1903							44.0	38.5	
1904							21.9	15.2	
1905							-	-	
1906							24.3	18.3	
1907					37.0	28.3	50.0	24.6	
1908					24.3	33.8	38.5	32.5	
1909					26.8	35.7	-	-	
1910					17.4	26.8	34.3	26.0	
1911					5.7	23.3	14.2	11.5	
1912					0	0	-	-	
1913					13.5	27.0	32.1	31.7	31.3
1914					10.5	20.1	20.3	21.3	14.9
1915					25.8	38.7	-	-	24.3
1916					16.7	22.8	10.0	7.6	8.6
1917					5.5	12.3	35.9	34.6	32.4
1918					3.5	19.5	39.3	29.1	18.8
1919					0	5.3	17.9	15.7	16.4
1920					15.6	21.1	26.5	12.2	28.7
1921					3.9	5.7	26.6	19.4	11.7
1922					23.5	27.6	22.8	26.6	21.8
1923					10.3	14.8	33.0	32.2	23.6
1924					18.0	27.0	43.3	45.3	35.8
1925					4.5	20.0	35.0	29.3	27.5
1926					0	11.0	35.3	24.2	24.7
1927					11.8	22.3	34.2	30.6	22.5
1928					12.5	29.2	41.7	28.9	23.8
1929					10.2	15.3	34.6	31.2	27.8
1930					7.3	20.0	44.7	41.4	27.7
1931					1.0	2.5	35.3	35.0	34.2
1932					15.7	24.2	29.0	33.3	29.7
1933					1.8	14.3	24.2	29.9	19.7
1934					1.3	8.0	17.6	14.2	21.1
1935					13.5	11.5	30.1	31.6	10.7
1936	16.8	15.5	21.8	20.8	0	0	5.8	10.0	8.7
1937	0	13.5	14.3	13.7	10.0	5.3	21.9	30.1	13.8
1938	9.7	24.5	24.8	26.7	4.3	7.7	37.3	30.7	38.3
1939	17.3	31.3	33.8	22.7	17.0	26.7	30.2	21.5	28.9
1940	0	22.3	20.5	25.3	8.7	14.3	15.1	19.7	28.3
1941	16.3	22.7	20.5	27.8	12.3	17.0	27.9	28.0	34.6
1942	17.8	44.3	28.2	51.3	28.7	48.0	54.3	48.0	46.9
1943	0	0	0	0	17.8	19.5	20.3	24.0	16.0
1944	2.5	27.2	25.8	18.8	20.2	39.5	21.1	23.1	24.7
1945	1.5	53.0	53.8	58.0	13.2	26.7	32.2	27.7	29.0
1946	10.7	41.0	33.3	36.2	9.3	27.0	31.9	24.6	30.1
1947	20.2	45.3	43.5	52.7	15.0	18.5	28.9	23.2	28.7
1948	6.8	48.0	49.2	47.7	21.7	34.5	37.8	27.1	30.9
1949	2.7	19.3	19.7	17.2	3.2	7.2	30.8	29.2	27.9
1950	7.5	39.3	35.8	32.2	11.5	17.5	21.7	39.4	24.8
1951	7.8	31.7	30.3	35.2	13.7	22.2	34.7	39.7	28.0
1952		30.3	30.2	32.0	7.5	8.2	20.4	17.7	14.5
1953		33.8	33.0	29.9			13.4	25.6	14.4
1954		15.2	16.6	21.6			8.6	28.7	
1955		60.6	64.2	53.5			21.3	27.7	
1956							35.5	32.9	

WHEAT RAW DATA

YEAR	(55)	(56)	(57)	(58)	(59)	(60)	(61)	(62)	(63)
1900									
1901									
1902									
1903									
1904									
1905									
1906									
1907									
1908									
1909									
1910									
1911									
1912									
1913	35.2	38.2	38.2	39.3	31.7	29.2			
1914	15.5	16.1	14.2	15.2	21.3	13.3			
1915	28.3	26.8	26.9	30.0	-	-			
1916	8.8	9.5	8.8	10.5	7.6	4.4			
1917	36.8	37.9	37.0	35.8	34.6	34.7			
1918	25.7	27.3	27.2	26.1	29.1	26.5			
1919	16.4	16.3	16.5	15.7	15.7	10.6			
1920	31.4	33.0	27.6	27.5	12.2	13.2			
1921	13.0	13.2	13.2	13.2	19.4	13.4			
1922	26.6	29.0	29.8	30.5	26.6	14.2			
1923	26.3	27.0	27.2	26.7	25.5	20.5			32.2
1924	41.4	44.3	45.8	47.4	39.5	38.2			45.3
1925	33.1	33.6	33.5	33.2	23.9	17.8			29.3
1926	28.5	31.2	31.7	31.9	18.2	16.1			24.2
1927	28.4	27.1	26.2	26.3	26.2	20.2			30.6
1928	29.0	30.8	30.6	27.6	27.0	32.2			28.9
1929	36.3	40.1	39.9	41.1	29.3	26.2			31.2
1930	37.0	42.7	44.7	40.7	38.0	38.8		39.2	41.4
1931	37.2	40.7	41.0	40.9	30.5	29.4		33.5	35.0
1932	29.0	30.4	31.0	32.7	28.6	26.3		29.6	33.3
1933	17.9	19.1	18.7	18.0	28.0	29.7		29.0	29.9
1934	23.0	25.3	25.6	28.0	14.8	15.3		14.2	17.3
1935	14.7	13.9	13.0	11.7	11.7	8.8		31.6	20.3
1936	10.1	10.1	11.5	12.3	9.0	7.6	9.7	10.0	10.1
1937	15.0	16.0	15.2	16.2	12.0	7.8	31.4	30.1	20.2
1938	38.5	37.5	40.9	40.9	17.8	6.1	37.1	30.7	23.2
1939	29.2	32.1	31.4	33.8	23.6	22.5	26.8	26.3	26.1
1940	26.6	26.9	27.2	25.6	14.7	13.3	18.0	19.4	17.5
1941	39.9	41.0	40.8	41.9	17.2	17.1	28.0	22.0	23.6
1942	54.8	53.8	52.6	46.5	39.2	33.2	44.5	38.3	42.6
1943	20.4	18.4	19.2	22.1	16.2	14.7	19.9	21.1	17.2
1944	34.4	34.3	31.4	23.0	15.7	15.5	20.9	22.4	18.2
1945	35.6	38.0	39.8	40.9	23.0	22.6	27.8	26.7	24.3
1946	34.9	33.6	34.1	37.9	26.2	25.6	28.1	26.5	27.1
1947	35.0	35.0	33.8	37.0	22.6	22.1	22.8	22.7	22.5
1948	36.1	34.7	36.2	33.4					
1949	34.4	35.0	34.4	31.7					
1950	31.7	29.9	31.4	28.6					
1951	38.9	37.7	38.1	43.2					
1952	17.4	23.9	24.6	20.5					
1953	17.2	18.9	18.0	18.1					

YEAR	(64)	(65)	(66)	(67)	(68)	(69)	(70)	(71)	(72)
1900			42.1						
1901			34.6						
1902			20.3						
1903			33.7						
1904			15.6						
1905			8.2						
1906			15.2						
1907			10.1						
1908			14.2						
1909			23.6						
1910			27.0						
1911			3.6						
1912			12.9						
1913			10.2						
1914		27.4	28.4						
1915		32.8	17.3	31.8	23.8	27.6	16.0	31.2	27.7
1916		15.3	10.6	2.8	4.2	4.5	2.2	1.8	3.3
1917		10.9	26.5	11.5	4.3	7.2	2.2	10.5	13.5
1918		8.5	20.0	9.8	6.0	6.0	0	9.2	8.3
1919		7.1	9.3	13.7	15.8	12.2	13.7	12.5	17.1
1920		7.0	30.7	12.5	19.5	9.8	9.3	12.3	24.7
1921		0.9	15.8	32.8	27.5	28.3	23.8	27.2	30.7
1922		18.9	8.3	34.5	28.5	27.2	13.3	30.3	36.2
1923		12.5	19.0	35.8	14.5	22.3	17.0	14.7	31.8
1924		20.2	40.7	7.5	13.5	10.3	13.7	9.3	20.5
1925		18.3	22.5	20.8	18.8	18.5	5.5	17.5	26.7
1926		17.0	18.1	29.7	20.5	20.8	12.5	25.5	28.8
1927		22.3	4.9	13.0	14.0	13.0	5.8	12.7	15.2
1928		16.6	22.7	19.7	14.0	19.5	5.3	22.0	30.8
1929		13.0	10.0	11.8	10.5	12.3	6.5	11.7	26.0
1930		10.8	20.1	22.2	16.3	20.2	6.8	18.7	28.5
1931		9.5	27.8	27.5	19.2	23.8	11.8	24.8	38.2
1932		22.4	21.9	26.7	21.3	20.5	13.0	19.7	32.2
1933	28.4	0	26.3	8.2	9.3	9.5	1.7	13.2	13.7
1934	16.4	0.9	34.3	23.3	13.7	15.0	4.8	21.0	16.3
1935	30.0	20.8	30.1	20.0	9.5	11.8	4.5	20.5	19.7
1936	8.6	0	18.9	20.8	17.2	19.3	12.0	17.5	23.3
1937	27.9	8.5	29.2	27.5	1[illegible].0	19.8	10.3	24.0	26.0
1938	33.8	11.5	24.9	39.8	31.[illegible]	29.7	27.5	33.7	47.7
1939	28.8	16.4	33.8	19.8	18.3	16.8	8.5	16.7	26.2
1940	16.1	8.8	33.5	13.7	5.3	8.8	3.7	16.3	22.7
1941	29.1	22.5	17.4	35.8	21.7	30.0	31.3	26.8	46.2
1942	47.3	21.2	18.8	18.0	16.2	13.5	9.7	26.0	26.5
1943	19.3	15.3	9.9	18.3	17.0	17.0	9.3	16.5	28.8
1944	20.9	23.1	28.6	31.3	23.7	23.5	13.2	24.2	48.9
1945	26.8	24.5	20.7	26.2	19.8	16.8	13.0	19.7	32.0
1946	26.9	-	27.8	20.8	17.8	19.3	10.3	18.2	29.3
1947	21.9	17.4	24.4	17.5	10.8	10.8	15.2	14.3	34.2
1948		19.1	19.3	9.7	10.2	11.0	8.5	10.2	22.2
1949			21.6						
1950			23.8						
1951			16.8						
1952			17.7						
1953			34.5						
1954			14.3						
1955			6.2						
1956			16.4						

YEAR-	(73)	(74)	(75)	(76)	(77)	(78)	(79)	(80)	(81)
1900									
1901									
1902									
1903									
1904									
1905									
1906									
1907									
1908									
1909									
1910									
1911									
1912									
1913									
1914									
1915									
1916									
1917									
1918									
1919									
1920									
1921									
1922	34.5	35.3	26.5	29.2	33.0	30.4	30.6	29.0	26.5
1923	14.0	9.8	27.5	35.8	45.0	39.8	37.3	35.6	42.7
1924	17.8	22.3	31.5	30.1	23.8	29.9	18.7	17.5	23.2
1925	16.7	20.2	31.7	34.9	34.6	38.9	27.5	25.2	25.0
1926	20.7	16.7	35.1	44.1	27.5	42.1	22.5	21.2	27.9
1927	14.8	13.2	14.8	18.9	23.8	20.2	10.3	7.2	7.1
1928	16.8	21.8	39.8	46.0	62.3	57.4	30.4	26.9	33.6
1929	13.0	19.5	18.4	13.9	15.3	17.6	10.1	15.2	18.2
1930	14.7	21.7	18.9	22.7	19.6	22.6	11.2	10.9	15.7
1931	22.3	25.7	29.5	27.6	10.5	13.8	15.6	12.8	16.4
1932	20.8	23.8	21.9	31.5	32.2	36.6	19.2	15.0	18.9
1933	10.2	11.7	7.8	7.3	4.4	10.8	5.2	4.2	9.4
1934	11.7	7.7	-	-	-	-	-	-	-
1935	9.2	9.8	30.7	37.7	33.3	39.3	19.0	19.4	24.1
1936	14.3	18.7	19.4	30.6	28.8	29.7	12.2	9.0	16.7
1937	17.0	14.8	37.6	24.8	10.3	8.8	8.7	9.6	8.9
1938	33.8	37.2	27.7	35.4	36.9	37.2	26.7	26.8	31.8
1939	18.8	19.5	-	-	26.7	29.2	19.7	19.5	24.2
1940	10.7	8.3	17.3	19.9	14.4	21.0	13.9	12.8	17.1
1941	33.3	35.5	22.4	30.5	38.7	26.2	8.7	10.3	23.3
1942	15.5	21.8	30.3	36.3	27.6	33.8	21.5	22.7	23.2
1943	17.5	19.2	55.0	52.3	55.8	46.1	34.8	41.0	46.1
1944	27.2	30.8	26.6	29.7	34.0	28.6	23.2	24.5	28.4
1945	20.5	22.0	33.8	32.7	23.7	22.2	22.8	24.4	26.4
1946	20.2	18.0							
1947	14.2	17.3							
1948	13.7	17.0							
1949									
1950									
1951									
1952									
1953									
1954									
1955									

YEAR	(82)	(83)	(84)	(85)	(86)	(87)	(88)	(89)	(90)
1900									
1901									
1902									
1903									
1904									
1905									
1906									
1907									
1908									
1909									
1910									
1911			42.3	42.2	45.6	45.1	48.6	46.1	36.8
1912			41.5	41.0	38.2	37.0	38.1	34.9	36.5
1913			-	-	-	-	-	-	-
1914			42.7	43.7	37.8	41.9	44.7	43.2	38.7
1915			34.8	39.7	37.6	38.8	42.7	45.8	33.2
1916			36.8	33.7	16.8	33.8	38.1	17.1	16.0
1917			35.8	38.2	23.7	34.8	34.4	36.7	15.4
1918			16.1	25.7	24.5	28.9	31.2	24.7	15.1
1919			53.6	61.5	57.0	65.5	64.9	68.5	52.3
1920			47.7	57.7	52.3	57.3	55.1	50.0	45.3
1921			48.2	47.5	46.7	55.0	54.0	46.3	34.8
1922	26.3	21.4	34.6	30.6	45.3	44.5	44.4	38.5	33.4
1923	46.1	44.1	50.2	44.1	49.1	48.5	47.5	41.9	37.3
1924	26.1	20.5	29.6	27.6	28.6	32.0	30.6	29.0	26.6
1925	34.9	33.1	43.7	46.8	41.8	48.3	45.3	49.8	39.7
1926	35.1	38.2							
1927	9.9	10.3							
1928	36.1	47.9							
1929	19.2	10.8							
1930	17.9	27.3							
1931	19.6	21.9							
1932	29.1	27.2							
1933	17.2	8.6							
1934	-	-							
1935	28.8	40.9							
1936	22.1	31.9							
1937	6.9	7.9							
1938	34.5	28.8							
1939	28.0	31.5							
1940	19.3	20.3							
1941	22.6	40.9							
1942	27.3	31.7							
1943	51.2	50.9							
1944	29.9	36.0							
1945	29.1	28.9							
1946									
1947									
1948									
1949									
1950									
1951									
1952									
1953									
1954									
1955									
1956									

YEAR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1900			956						
1901			1045						
1902			701						
1903			836						
1904			800						
1905			816						
1906			700						
1907			768						
1908			747						
1909			626						
1910			628						
1911			915						
1912			845						
1913			590						
1914			382						
1915			789						
1916			--						
1917			--						
1918			--						
1919			--						
1920			512						
1921			472						
1922			1083						
1923			515						
1924			1040						
1925			0						
1926			1222						
1927			1410						
1928			602						
1929			1038						
1930	562	1077	1240	814	1288	556	1318	870	1445
1931	901	1487	1030	1125	1100	1088	2049	1683	986
1932	1450	1110	1466	1291	1224	1626	1857	1390	1330
1933	1091	812	1166	1169	1547	1398	2304	2016	1499
1934	1396	1494	1096	1443	1361	1440	2013	1506	1424
1935	1528	923	1454	1271	1589	1636	2345	1097	1640
1936	84	1412	1334	1268	1752	1126	1523	1311	1778
1937	1662	1315	970	1363	1652	1154	2067	1663	2009
1938	1537	1334	1622	2152	1680	1557	1978	1941	1843
1939	1798	1953	1390	734	1258	1942	2274	2266	1064
1940	1181	1544	1068	1220	960	1490	1783	1418	1717
1941	1541	2228	1049	1413	817	1685	2500	2216	1616
1942	2025	1834	1032	1649	1808	1413	2141	1226	1620
1943	1587	1892	1459	2147	826	1604	1925	1491	2025
1944	1545	1955	1656	2175	2189	2441	1852	1826	1539
1945	1305	1899	811	1877	1669	1762	2104	1648	1698
1946	990	1537	208	1034	983	752	1998	1418	1719
1947	1536	1512	1603	1454	1756	1235	1811	1693	835
1948	1574	1816	2563	1998	2677	1942	2302	1811	1770
1949	1314	1717	1582	1159	2444	1429	1702	1862	565
1950	1095	1818	1529	2139	1076	1852	1041	2385	1583
1951	1590	1199	1498	1840	1922	1654	2221	1136	1802
1952	1419	655	998	1907	1202	1390	1761	861	1182
1953	1836	864	1836	1987	2484	1652	1422	1851	2484
1954	738	756	1030	2275	1973	1253	1573	765	2804
1955	1581	2542	3026	2901	2905	3028	1666	2023	2276

[illegible]

Year	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1911									1750
1912									1230
1913									1840
1914									1200
1915									1040
1916									1840
1917									1760
1918									820
1919								2000	1600
1920								1330	655
1921	1384	1461	1562	1702	1723	1803	1705	1980	2080
1922	733	834	902	967	972	1008	1083	1480	1240
1923	457	622	768	879	991	958	874	885	1060
1924	1168	1190	1198	1309	1369	1470	1456	1550	1220
1925	2604	3060	2965	3020	2903	3010	3050	1544	1798
1926	2074	2216	2362	2554	2863	3112	3102	1752	2160
1927	1315	1503	1657	1927	2704	2780	2790	1648	1680
1928	1628	1838	1959	2023	2201	2313	2390	1216	1632
1929	1382	1543	1663	1820	2038	2127	2257	1536	1520
1930	801	853	893	1115	1113	1136	1149	1040	992
1931	1189	1326	1410	1444	1411	1556	1542	1496	1632
1932	645	711	828	889	963	1012	1052	1616	1600
1933	886	973	1091	1235	1493	1542	1656	1480	1424
1934	778	854	939	964	1012	1036	1075	1408	1056
1935	1048	1179	1207	1370	1434	1599	1651	968	640
1936	777	840	999	1082	1169	1085	1121	1720	1280
1937	902	1106	1257	1452	1620	1765	1798	2280	1520
1938	1167	1275	1417	1681	1781	1931	1999	1728	1600
1939	961	1036	1210	1244	1556	1545	1540	1032	1632
1940	949	1080	1252	1444	1549	1575	1586	1488	1536
1941	1104	1220	1435	1654	1875	2079	2236	1504	1120
1942	886	956	1198	1455	1487	1581	1794	2400	1888
1943	945	1045	1127	1247	1357	1421	1456	1696	1360
1944	836	923	1061	1284	1498	1437	1508	1480	1248
1945	654	869	1060	1424	1539	1763	1753	1816	1792
1946	736	817	1065	1116	1160	1331	1508	2344	1584
1947	903	1313	1168	1285	1577	1674	1868	1600	1296
1948	866	981	1163	1436	1610	1880	1917	2280	1408
1949	874	965	1134	1243	1419	1515	1585	2320	
1950	557	774	896	921	1035	1126	1076	1656	
1951	678	687	816	921	1042	1079	1127	1560	
1952	840	758	944	1050	1315	1468	1563	1296	
1953	1151	1253	1658	1785	1945	2086	2156	1344	
1954	995	1067	1267	1318	1415	1377	1384	1320	
1955	1194	1161	1382	1583	1825	2122	2399	2008	
1956	686	729	797	914	1161	1245	1237		

Year	(19)
1911	1420
1912	1042
1913	1640
1914	1440
1915	1970
1916	1520
1917	1200
1918	642
1919	1680
1920	1215
1921	1720
1922	1440
1923	875
1924	1260
1925	1499
1926	1632
1927	1288
1928	1104
1929	1064
1930	952
1931	1206
1932	1496
1933	1152
1934	1224
1935	848
1936	1560
1937	1704
1938	1616
1939	1072
1940	1328
1941	1240
1942	1760
1943	1464
1944	1280
1945	1296
1946	2408
1947	1312
1948	1760
1949	1784
1950	1192
1951	1576
1952	1128
1953	1120
1954	1208
1955	1993
1956	

YEAR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1935	508	1080	1158	1004					
1936	416	982	1056	918					
1937	874	1072	996	920					
1938	868	898	806	852					
1939	1332	1384	1304	1494					
1940	1070	1100	900	782					
1941	654	984	990	890					
1942	670	984	1090	834					
1943	506	602	504	532					
1944	800	784	826	828					
1945	1247	1665	1431	1310					
1946	814	1449	1606	1161	2117	1640			
1947	1120	1235	1305	1129	1771	1481	1576	1857	1728
1948	1471	1692	1777	-	1944	2099	1740	1794	1852
1949	845	1123	1245	1160	2348	2307	2171	2327	2104
1950					1729	1731	1783	1925	1839
1951					1750	1804	1589	1743	1550
1952					1595	1768	1384	1524	1440
1953					1913	2034	1656	1921	1612
1954					2084	2185	2019	1822	1637
1955					1895	1948	1779	1714	1648

YEAR	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1946	1705		1347		1190		1374		2036
1947	1705	1544	1587	1226	1067	1396	1276	1677	1523
1948	1903	1502	1587	1336	1371	1819	1788	1995	2181
1949	2088	1972	2108	1242	1204	1567	1557	1743	2273
1950	1745	1641	1663	844	928	1374	1408	1246	1652
1951	1656	1256	1298	978	1038	1351	1230	1680	1764
1952	1400	1242	1262	938	1131	1351	1477	1602	1508
1953	1880	1449	1642	980	950	1283	1388	1792	1868
1954	1826	1498	1680	1359	1217	1703	1767	1869	1879
1955	1834	1449	1686	967	1002	1450	1468	1718	1915

YEAR	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
1946		1676		2119		1826	1870	1813	2017
1947	1451	1431	1589	1637	1272	1318	1268	1248	1577
1948	2083	1962	1874	2146	1562	2002	1996	1750	2158
1949	1778	2092	2009	2141	2016	2065	2031	2096	2435
1950	1664	1421	1554	1747	1609	1538	1438	1268	2193
1951	1506	1590	1861	1540	1494	1662	1735	1539	1592
1952	1555	1640	1840	1958	1653	1838	1847	1781	1866
1953	1736	1705	1578	2108	1619	1829	1977	1938	2289
1954	1788	1839	1882	2123	1586	1586	2044	2034	2140
1955	1715	1768	1849	1917	1525	1815	1712	1731	1942

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YEAR	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
1935	1186	925	1002	1174	1348	1148	1227	1223	1168
1936	-	-	-	-	-	-	789	951	778
1937	1285	1506	1330	1381	1355	1429	1575	1209	1365
1938	1632	1577	1610	1582	1621	1489	1821	1617	1584
1939	1182	1042	963	1063	1271	1255	1191	1160	1157
1940	1368	1393	1555	1467	1589	1531	1416	1386	1315
1941	1272	1373	1566	1289	1414	1313	1671	1173	1104
1942	1368	1375	1336	1310	1288	1256	1481	1344	1446
1943	1424	1571	1528	1813	1758	1662	1538	1532	1956
1944	1868	1854	2046	2170	1879	1984	1950	1954	1820
1945	1306	1424	1318	1242	1289	1232	1523	1372	1210
1946	1771	1743	1626	1684	1984	1770	1578	1719	1722
1947	1332	1406	1257	1562	1470	1511	1444	1220	1286
1948	1765	1797	1835	1828	1782	1785	2186	1955	1731
1949	1707	1607	1739	1812	2046	1902	1883	1770	2136

YEAR	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)
1935	1307	1338	1249	1144	1171	1384	1381	1331	1283
1936	-	-	-	746	-	-	-	-	-
1937	1446	1604	1538	1254	1426	1486	1327	1008	1166
1938	1694	1485	1875	1694	1739	1677	1599	1578	1615
1939	1075	1374	1158	1192	1057	1106	1283	1197	1108
1940	1525	1438	1541	1177	1260	1387	1388	1026	1405
1941	1376	1094	1375	1486	1434	1449	1510	1060	1333
1942	1463	1535	1623	1621	1529	1690	1477	1318	1371
1943	1544	1984	1434	1765	1522	1689	1695	1859	1635
1944	2035	1774	1932	1827	2074	1969	1827	1885	2043
1945	824	1433	1446	1478	1336	1597	1530	1278	1538
1946	1823	1575	1751	1900	2044	2028	1737	1592	1715
1947	1311	1460	1451	1409	1457	1427	1385	1587	1507
1948	1836	2006	1783	1548	1648	1775	1519	1657	1981
1949	2045	2026	1900	1681	1997	1977	1857	1774	1999

YEAR	(46)	(47)	(48)	(49)	(50)	(51)	(52)
1924							413
1925							588
1926							751
1927							631
1928							631
1929							718
1930							600
1931							839
1932				1518			1235
1933			1348	1614		1348	824
1934			1540	1908		1540	1255
1935	1628		1539	1740		1539	1204
1936	1413		1584	1713		1584	929
1937	1054		1324	1451		1324	1088
1938	1560		1686	1791		1686	1068
1939	1221		1318	1310	1705	1318	1132
1940	1554		1375		1658	1375	1036
1941	1137		1459		1515	1459	1124
1942	1531		1364		1154	1364	1287
1943	1276		1537		1450	1537	1258
1944	828		1280		1445	1280	1315
1945	1751		1476		1710	1476	1308
1946	2097	3023			3023	-	1360
1947	1650	2462			2462	2016	1241
1948	2520	2207			2207	1695	1362
1949	1455	2107			2107		1400
1950		2072			2072		1541
1951		2224			2224		1404
1952		1492			1492		1513
1953		1836			1836		1512
1954		2089			2089		1434
1955		1333			1333		1445

LOCATION AND SOURCES OF DATA WITH SELECTED COMMENTS

The numbers to the left on the pages in this section refer to the numbers at the top of the individual series of raw data in the preceding sections for each crop. The location and source of each series is presented with some comments to identify the series in each case.

Corn Raw Data

(1) Urbana, Ill., Agronomy South Farm; Runge, E.C.A., The Relation Between Precipitation, Temperature, and Yield of Corn on the Agronomy South Farm, Urbana, Illinois, Unpublished M.S. Thesis, Agronomy Department, U. of Illinois, 1957. Open polinated corn was planted until 1939, hybred from 1940-56. Drummer soil. First year corn, North Central Rotation.

(2) Same as (1) except second year corn, North Central Rotation.

(3) Urbana, Ill., Morrow plots; Bauer, F. C., C. H. Farnham, and L. B. Miller, The Morrow Plots, Dept. of Agron., U. of Ill., Mimeo., 1956. Fertilization MLP. continuous corn.

(4) Ames, Iowa, obtained through correspondence with W. D. Shrader, Department of Agronomy, Iowa State College, Ames, Iowa. Nicollet loam soil. Check plot. Yields prior to 1936 adjusted for hybred seed by formula Y = 8.97 + .96X.

(5) Same as (4) except manure applied.

(6) Same as (4) except manure and lime applied.

(7) Same as (4) except lime applied.

(8) Same as (4) except a different check plot.

(9) Columbia, Mo.; Smith, G. E., Sandborn Field, Mo. A.E.S. Bul. 458, 1942. Plot 18. 6 T. manure applied annually. Continuous corn.

(10) Lincoln, Neb.; Iowa Res. Bul. 166. Open pollinated, Hogue Dent until 1933, open pollinated Krug 1934-48.

(11) Lincoln, Neb.; Kiesselbach, T.A. and W.E. Lyness, Crop Rotation Experiments, Neb. A.E.S. Bul. 416, 1952. U.S. 13 until 1944, Ohio O 92 from 1945-51 (both similar). Rotation 9: W, with manure-C-O-Swcl-C-B.

(12) Same as (11) except Rotation 9: W, with manure-C-O-Swcl-Swcl-C-B.

(13) Same as (11) except Rotation 4: W-C-O-Swcl-Swcl-C-B.

(14) Same as (13) except different plot.

(15) Same as (11) except Rotation 2: W-C-O-C-C-B.

(16) Same as (15) except different plot.

(17) Same as (15) except different plot.

(18) Lincoln, Neb.; obtained through correspondence with D. P. McGill, Department of Agronomy, U. of Neb., Lincoln, Neb. Mean yields in same series of plots. Check plots in long term fertility study. Fields 2, 3, and 4, Agronomy Farm.

(19) N. Platte, Neb.; Zook, L. L. and H. E. Weakly, Crop Rotation and Tillage Experiments at the North Platte (Neb.) Substation, 1907-34, U.S.D.A. Tech. Bul. 1007, 1950. Av. on 3 experimental fields.

(20) N. Platte, Neb.; obtained through correspondence with R. E. Ramig, College of Agriculture Experiment Substation, North Platte, Neb. Corn after oats, spring plowed, 3 yr. rotation, summer fallow-O-C. Rotation 50.

(21) Same location and source as (20). Open pollinated, Substation White, continuous corn, alt. fallow.

(22) Same as (21) except continuous corn after fall blank listing.

(23) Same as (21) except continuous corn after fall plowing.

(24) Same as (21) except continuous corn after spring plowing.

(25) Same as (21) except Rotation 474, alt. W and C, 2 yr. rot.

(26) Same as (21) except Field C Check Rot., Fallow-W-C-C-W.

(27) Same as (26) except different plot.

(28) Same as (21) except Rotation 643, Field A, 4 yr. Rot. Fallow-W-C-W.

(29) Wooster, Ohio; obtained through correspondence with J. L. Haynes, Department of Agronomy, Ohio Agricultural Experiment Station, Wooster, Ohio. Wooster silt loam soil. Average of 8 rotations where corn follows legume. Changed from open pollinated to hybred, 1935. Changed from broadcast to raw application of fertilizer, 1940.

Oats Raw Data

(1) Urbana, Ill.; obtained through correspondence with L. B. Miller, Department of Agronomy, U. of Ill., Urbana, Ill. Details of original plan described in Ill. A.E.S. Bul 273 beginning on page 279. Crop residue and rock phosphate 1904-10. Crop residue, rock phosphate, and limestone, 1910-52.

(2) Ames, Iowa; obtained through correspondence with W. D. Shrader, Department of Agronomy, Iowa State College, Ames, Iowa. Clarion and Nicollet soil. Check plots 805 and 811 average.

(3) Same as (2) except a different single check plot.

(4) Columbia, Mo.; Smith, G. E., Sandborn Field, Mo. A.E.S. Bul. 458, 1942. No fertilization. Plot 16. Continuous oats.

(5) Same as (4) except Plot 15 and 6 T. manure applied.

(6) Lincoln, Neb.; Kiesselbach, T. A. and W. E. Lyness, Production Practices for Spring Small Grains, Neb. A.E.S. Bul 406, 1951. Varieties: Kherson, 1917-34, Iogold, 1935-42, others 1943-50. Medium planting. Single field. C-O-W rotation.

(7) Lincoln, Neb.; obtained through correspondence with D. P. McGill, Department of Agronomy, Univ. of Neb., Lincoln 3, Nebraska. Average of three varieties. Same field (K), campus.

(8) Same as (7) except fields 2, 3, and 4, agronomy farm.

(9) Lincoln, Neb.; Kiesselbach, T. A. and W. E. Lyness, Crop Rotation Experiments, Neb. A.E.S. Bul. 416, 1952. Rotation 9, W with manure-C-O and Sw.cl.-Sw.cl.-C-B. Varieties: Trojan 1942, Cedar 1943-7, Clinton 1948, Nemaka 1949-51.

(10) Same as (9) except Rotation 4, W-C-O-Sw.cl.-Sw.cl.-C-B.

(11) Same as (9) except Rotation 2, W-C-O-C-C-B.

(12) N. Platte, Neb.; Zook. L. L. and H. E. Weakly, Crop Rotation and Tillage Experiments at the North Platte (Neb.) Substation, 1907-34., U.S.D.A., Tech. Bul. 1007, 1950. Average of 3 fields.

(13) N. Platte, Neb.; obtained through correspondence with R. E. Ramig, Univ. of Neb. Exp. Substation, N. Platte, Neb. Varieties: Neb. 21, 1936-7, Brinker, 1938-48. Continuous oats--oats every other year on summer fallow.

(14) Same as (13) except continuous oats--after blank listing in fall.

(15) Same as (13) except continuous oats--after early fall plowed.

(16) Same as (13) except continuous oats--after spring plowing.

(17) Same location and source as (13). Rotation 9, 3 year rotation C-O-W.

(18) Same location and source as (13). Oats on fallow. 3 year rotation, summer fallow-O-W. Rotation 8.

(19) Same as (18) except Rotation 50.

(20) Dickinson, N. D.; N. D. A.E.S. Bul. 383. Continuous oats--alternated fallow.

(21) Same as (20) except not alternate fallow.

(22) Fargo, N. D.; obtained through correspondence with T. E. Stoa, Agronomy Dept., North Dakota Agricultural College, State College Station, Fargo, N. D. Check plot. Livestock series.

(23) Same as (22) except fr., man., livestock series.

(24) Same as (22) except fr., man., and P, livestock series.

(25) Same as (22) except fr., man., P, and Ca, livestock series.

(26) Same as (22) except fr., man., P, Ca, and K, livestock series.

Barley and Soybeans Raw Data

Barley

(1) Alliance, Neb.; obtained through correspondence with Robert O'Keefe, Box Butte Experiment Farm; Alliance, Neb., average of all rotations.

(2) N. Platte, Neb.; Neb. A.E.S. Bul. 362. Fallow.

(3) N. Platte, Neb.; U.S.D.A. Tech. Bul. 1007. Average of three experimental fields.

(4) Dickinson, N. D.; N. D. A.E.S. Bul. 383. Continuous barley--alternate fallow.

(5) Same as (4) except not alternate fallow.

Soybeans

(6) Urbana, Ill.; obtained through correspondence with L. B. Miller, Agronomy Department, Univ. of Ill., Urbana, Ill. South Central Rotation-C-C-C-SB.

Wheat Raw Data

(1) Akron, Col.; U.S.D.A. Circ. 700. Variety: Karkof. Average of all plots growing the particular variety.

(2) Same as (1) except Turkey variety 1900-15 and Karkof 1916-38 (i.e.--(1) is the same as the Karkof part of (2).)

(3) Urbana, Ill.; obtained through correspondence with L. B. Miller, Agronomy Dept., Univ of Ill., Urbana, Ill. C-O-cl-W rotation.

(4) Colby, Kan.; U.S.D.A. Tech. Bul. 761, Jan. 1941. C or D fallow.

(5) Colby, Kan.; Kan. A.E.S. Bul. 273. Average of late and early plowed and fallow.

(6) Garden City, Kan.; U.S.D.A. Tech. Bul. 761, 1941. Continuously cropped. Winter wheat.

(7) Same as (6) except average of all fallow.

(8) Same as (6) except C or D fallow.

(9) Garden City, Kan.; Kan. A.E.S. Bul. 262. Fallow, fall listed. Winter wheat.

(10) Same as (9) except early listed.

(11) Same as (9) except subsoiled.

(12) Same as (9) except late plowed.

(13) Same as (9) except early plowed.

(14) Hays, Kan.; U.S.D.A. Tech. Bul. 761, 1941. Average of all fallow.

(15) Same as (14) except continuously cropped.

(16) Hays, Kan.; Kan. A.E.S. Tech. Bul. 85, 1956. Fallow, wheat, wheat, wheat rotation.

(17) Same as (16) except fallow, wheat, wheat rotation.

(18) Columbia, Mo.; Mo. A.E.S. Bul. 458. Plot 10. Continuous wheat.

(19) Same as (18) except Plot 5, continuous wheat.

(20) Same as (18) except Plot 2, continuous wheat.

(21) Same as (18) except Plot 36, continuous wheat.

(22) Same as (18) except Plot 30, continuous wheat.

(23) Same as (18) except Plot 29, continuous wheat.

(24) Same as (18) except Plot 24, continuous wheat.

(25) Same as (18) except Plot 21, continuous wheat.

(26) Lincoln, Neb.; Neb. A.E.S. Bul. 389. Turkey variety. Ave. planting date Oct. 8.

(27) Same as (26) except ave. planting date Sept. 23.

(28) Same as (26) except ave. planting date Oct. 1.

(29) Lincoln, Neb.; obtained by correspondence with D. P. McGill, Dept. of Agronomy, Univ. of Neb., Lincoln 3, Neb. Mean yields in same series of plots. Check plots in long term fertility study. Fields 2, 3, and 4. Agronomy Farm.

(30) Lincoln, Neb.; Neb. A.E.S. Bul. 416. Rotation 9: W with manure-C-O- and Sw.cl.-C-B. Varieties: Nebred, 1942; Pawnee, 1943-51.

(31) Same as (30) except Rotation 9: W-C-O with Sw.cl.-Sw.cl.-C-B.

(32) Same as (30) except Rotation 2: W-C-O-C-C-B.

(33) N. Platte, Neb.; U.S.D.A. Tech. Bul. 1007. Field 49. Late plowing. Plot A.

(34) Same as (33) except early plowing. Plot B.

(35) Same as (33) except ave. of 3 fields.

(36) Same as (33) except late plowing, Series I and III, plots 4 and 16.

(37) Same as (33) except field 42, early plowing, Series II and IV, plots 4 and 16.

(38) N. Platte, Neb., obtained through correspondence with R. E. Ramig, Univ. of Neb. Exp. Substation. N. Platte, Neb. Rotation 47. Alternate W and C.

(39) Same as (38) except Field C, check rotation: Fallow-W-C-C-W.

(40) Same as (39) except mean of 6 replications.

(41) Same as (38) except Rotation 643, Field A--4 yr. rotation: Fallow-W-C-W.

(42) Same as (41) except different series.

(43) Same as location and source of (38) except Cheyenne variety, alternate fallow.

(44) Same as (43) except continuous wheat, early fall, blank listed.

(45) Same as (43) except continuous wheat, early fall plowed.

(46) Same as (43) except continuous wheat, late fall plowed.

(47) Same location and source as (38) except Rotation 269: Alternate W-Fallow. 10 %. manure topdressed in fall after emergency.

(48) Same as (47) except 10 T. manure plowed down every other year, Rotation 268: Alternate W-Fallow.

(49) Same as (47) except no fertilizer, Rotation 267: Alternate W-Summer fallow.

(50) Dickinson, N. D., N. D. A.E.S. Bul. 383. Continuous wheat.

(51) Same as (50) except alternate fallow.

(52) Fargo, N. D.; obtained through correspondence with T. E. Stoa, Agronomy Dept., North Dakota, Agricultural College, State College Station, Fargo, N. D. Variety: Durum--Kubanka 929, 1901-19; Mindum, 1920-56.

(53) Same as (52) except Hard Red Spring variety.

(54) Same as (53) except Check, livestock series.

(55) Same as (53) except Fr. Manure, livestock series.

(56) Same as (53) except Fr. Manure, and P, livestock series.

(57) Same as (53) except Fr. Manure, P, and Ca, livestock series.

(58) Same as (53) except Fr. Manure, P, Ca and K.

(59) Fargo, N. D.; N. D. A.E.S. Bul. 350. Variety: Marqus. Variety trials.

(60) Same as (59) except Power Fife variety.

(61) Same as (59) except Rival variety.

(62) Same as (59) except Thatcher variety.

(63) Same as (59) except Ceres variety.

(64) Same as (59) except Pilot variety.

(65) Mandan, N. D.; N. D. A.E.S. Bul. 362.

(66) Stillwater, Okl.; obtained through correspondence with A.M. Schlehuber, Agronomy Dept., Oklahoma State Univ., Stillwater, Okl. Varieties: Local Turkey, 1900-04; Fultz, 1905-7; Sibley's New Golden, 1908-11; Karkof, 1912-16; Turkey Red, 1917-20; Kanred, 1921-35; Tenmarq, 1936-45; Pawnee, 1946-56. Ave. of manured and unmanured, 1905-20.

(67) Woodward, Okl.; U.S.D.A. Circ. 917. Field A. Alternate cropped and fallowed.

(68) Same as (67) except continuously cropped, early listed.

(69) Same as (68) except early plowed, 8 in. deep.

(70) Same as (68) except late plowed.

(71) Same as (67) except ave. of unmanured rotations, Field A.

(72) Same as (67) except ave. of manured rotations, Field A.

(73) Same as (68) except early disked, onewayed.

(74) Same as (68) except early plowed 4 in. deep.

(75) Pullman, Wash.; Wash. A.E.S. Bul. 476. Field 3, Plot 108, Manure.

(76) Same as (75) except Plot 107, straw and NH_3NO_3.

(77) Same as (75) except Plot 106, $NaNO_3$.

(78) Same as (75) except Plot 105, Straw and $NaNO_3$.

(79) Same as (75) except Plot 104, no treatment.

(80) Same as (75) except Plot 103, straw.

(81) Same as (75) except Plot 103, straw and alf. hay.

(82) Same as (75) except Plot 101, alf. hay.

(83) Same as (75) except Plot 100, straw and $NaNO_3$.

(84) Pullman, Wash.; Wash. A.E.S. Bul. 207. Variety: Red Russian. Field Plots.

(85) Same as (84) except Little Club variety.

(86) Same as (84) except Jones Fife variety.

(87) Same as (84) except Hybred 123 variety.

(88) Same as (84) except Hybred 128 variety.

(89) Same as (84) except Hybred 143 variety.

(90) Same as (84) except Forty fold variety.

Cotton Raw Data

(1) Alexandria, Ala.; obtained through correspondence with H. T. Rogers, Dept. of Agronomy and Soils, Alabama Polytechnic Institute, Auburn, Ala. Change in fert. 1949.

(2) Aliceville, Ala.; same as (1) otherwise.

(3) Auburn, Ala.; same source as (1). One plot from 1900-55.

(4) Brewton, Ala.; same as (1) otherwise.

(5) Monroeville, Ala.; same as (1) otherwise.

(6) Prattville, Ala.; same as (1) otherwise.

(7) Sand Mountain, Ala.; same as (1) otherwise.

(8) Tennessee Valley, Ala.; same as (1) otherwise.

(9) Wiregrass, Ala.; same as (1) otherwise.

(10) Stoneville, Miss.; obtained through correspondence with Perrin H. Grissom, Delta Branch Experiment Station, Stoneville, Miss. No nitrogen.

(11) Same as (10) except 7.5 lb. nitrogen.

(12) Same as (10) except 15.0 lb. nitrogen.

(13) Same as (10) except 22.5 lb. nitrogen.

(14) Same as (10) except 30.0 lb. nitrogen.

(15) Same as (10) except 37.5 lb. nitrogen.

(16) Same as (10) except 45.0 lb. nitrogen.

(17) Jackson, Tenn.; obtained through correspondence with J. R. Overton, West Tennessee Experiment Station, Jackson, Tenn. Limed.

(18) Same as (17) except 35 lb. P_2O_5 etc.

(19) Same as (17) except unlimed.

Tobacco Raw Data

(1) Campbellesville, Ky.; obtained from G. L. Johnson, Dept. of Ag. Economics, Michigan State Univ., E. Lansing, Mich. Data obtained for his study of burley tobacco control programs. Burley tobacco. Line 10.

(2) Same as (1) except Line 7.

(3) Same as (1) except Line 4.

(4) Same as (1) except Line 1.

(5) Lexington, Ky.; obtained through correspondence with C. E. Bortner, Dept. of Agronomy, U. of Kentucky, Lexington 29, Ky. Plot 802. Variety: Ky. 16.

(6) Same as (5) except Plot 801.

(7) Same as (5) except Plot 432.

(8) Same as (5) except Plot 433.

(9) Same as (5) except Plot 434.

(10) Same as (5) except Plot 803.

(11) Same as (5) except Plot 435.

(12) Same as (5) except Plot 804.

(13) Same as (5) except Plot 436.

(14) Same as (5) except Plot 805.

(15) Same as (5) except Plot 437.

(16) Same as (5) except Plot 806.

(17) Same as (5) except Plot 438.

(18) Same as (5) except Plot 807.

(19) Same as (5) except Plot 439.

(20) Same as (5) except Plot 808.

(21) Same as (5) except Plot 440.

(22) Same as (5) except Plot 810.

(23) Same as (5) except Plot 441.

(24) Same as (5) except Plot 809.

(25) Same as (5) except Plot 811.

(26) Same as (5) except Plot 812.

(27) Same as (5) except Plot 813.

(28) Lexington, Ky., same source as (1). Burley tobacco. Line 1.

(29) Same as (28) except Line 2.

(30) Same as (28) except Line 3.

(31) Same as (28) except Line 4.

(32) Same as (28) except Line 5.

(33) Same as (28) except Line 6.

(34) Same as (28) except Line 7.

(35) Same as (28) except Line 8.

(36) Same as (28) except Line 9.

(37) Same as (28) except Line 10.

(38) Same as (28) except Line 11.

(39) Same as (28) except Line 12.

(40) Same as (28) except Line 13.

(41) Same as (28) except Line 14.

(42) Same as (28) except Line 15.

(43) Same as (28) except Line 18.

(44) Same as (28) except Line 17.

(45) Greenville, Tennessee; obtained from same source as (1).

(46) Greenville, Tennessee; obtained through correspondence with B. C. Nichols, Tobacco Experiment Station, Greenville, Tenn. Variety: Ky. 16. 3 yr. rotation.

(47) Same as (46) except Judy's Pride variety.

(48) Same as (47) except different plot.

(49) Same as (46) except different plot.

(50) Same as (47) except different plot.

(51) Blacksburg, Va.; obtained through correspondence with H. L. Duton, Agronomy Department, Virginia Polytechnic Institute, Blacksburg, Va., Station Yield. Several varieties.

APPENDIX B

FORM USED TO REMOVE TREND FROM BASIC DATA

CROP AND VARIETY ....
LOCATION ....
SOURCE OF INFO. ....
SOIL ....
FERTILIZATION ....
REMARKS ....

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(ΣY) $\Sigma u^2 =$ ( ) $\Sigma uy =$ ( ) $a = \frac{\Sigma Y}{n} =$ ( )

(1) $Y = a + bX$ $n =$ ( ) $b = \frac{\Sigma uy}{\Sigma u^2} =$ ( )