CHANGES IN INCOME DISTRIBUTION IN AGRICULTURE OVER THE PERIOD 1929 TO 1946 WITH REFERENCE TO THE ORGANIZATION OF GARFIELD COUNTY FARMS

CHANGES IN INCOME DISTRIBUTION IN AGRICULTURE OVER THE PERIOD 1929 TO 1946 WITH REFERENCE TO THE ORGANIZATION OF GARFIELD COUNTY FARMS

By

RUDOLF K. RINDERKNECHT

Dipl. Ing. Agr. E.T.H.

Eidgenossische Technische Hochschule

Zurich, Schweiz

1946

Submitted to the Department of Agricultural Economics

Oklahoma Agricultural and Mechanical College

In Partial Fulfillment of the Requirements

for the Degree of

MASTER OF SCIENCE

1948

APPROVED BY:

Chairman, Thesis Committee

Member of the Thesis Committee

Head of the Department

Dean of the Graduate School

ACKNOWLEDGEMENTS

The author has had the opportunity to study Agricultural Economics at the Oklahoma Agricultural and Mechanical College two semesters as an exchange student. Thanks are due to the Institute of International Education, as well as to the authorities of the Oklahoma Agricultural and Mechanical College, and the Swiss Federal Institute of Technology, and all known and unknown persons who have contributed to the successful operation of the student exchange. All connected with this exchange contribute to the international understanding, and in doing so to the world's desired goal--peace. May this student exchange further benefit students, not only some hundreds or thousands, but tens of thousands!

The writer wishes to express his sincere appreciation for the courteous assistance given, throughout his studies and especially this thesis, by Dr. P. Nelson, Dr. A. L. Larson, Mr. R. L. Tontz, Mr. G. P. Collins, Mr. K. C. Davis, Mr. L. A. Parcher and all the graduate students. It is a pleasure to be their friend.

TABLE OF CONTENTS

INDEX TO TABLES

INDEX TO FIGURES

CHANGES IN INCOME DISTRIBUTION IN AGRICULTURE OVER THE PERIOD 1929 TO 1946 WITH REFERENCE TO THE ORGANIZATION OF GARFIELD COUNTY FARMS

I. INTRODUCTION

American agriculture is characterized by its commerciality. A commercialized agriculture has a trend toward specialization. In specializing in one or two farm enterprises, the performance of a single farm task sums up to a large amount of monotonous work, which encourages the substitution of modern machinery for human labor, and also tractor power for animal power. However, many of the more diversified farms as well as smaller units still rely to a large extent on human labor and animal power. The application of modern farm machinery is therefore often neglected, even where machinery could be applied efficiently. Nevertheless, American agriculture, in view of a declining farming population and an increased production, recognizes the necessity of the introduction of modern machinery. An increase in application of modern machinery ordinarily enables farm operators to handle larger size units. For example, the number of farms in the state of Oklahoma with a size of 50 to 99 acres decreased from 48,362 in 1930 to 27,401 in 1945, the farms with a size of 260 to 499 acres increased from 20,704 to 24,752 (Table IV). During the same period the average size of Garfield County farms increased from 204.2 acres to 248.8 acres, an increase of 24 percent (Table V).

The major objective of this study is to determine the trend of the distribution of gross income to land, labor,

capital and management, and its effect on farm organization in Garfield County.

II. REVIEW OF LITERATURE

In determining the trend of gross income distribution to the production factors, the analysis is based on the breakdown of the final outcome which is the result of all economic activities in a firm. The final outcome of a firm is directly related to general economic principles. A short review of the literature treating such principles will indicate the relationship between the study of gross income distribution, the organization of the firm and these principles.

Peterson in his book Diminishing Returns and Planned Economy says:

> "Throughout all economics there is one central theme, 'the combination of variables'. In different semicomplete and incomplete economic universes the number, kind, degree of intensity, duration, etc. of the variables change. The problem of making a good, better, or best combination of all these variables to secure a desired result is very difficult."[1]

In many instances money income serves as a measurement of the goal. Considering the nation as a whole, this may not be true. As Peterson points out, the protection of home industries by tariff walls is considered beneficial by many people because it creates work, whereas the introduction of technical labor saving machinery is deemed detrimental because human labor is thereby displaced.[2] Tariffs definitely tend to reduce the total income of a nation, while labor-saving machinery makes

---

[1] George M. Peterson, Diminishing Returns and Planned Economy, pp. 13-14.

[2] Ibid., p. 14.

possible a higher standard of living. The displacement of labor through technological developments has actually taken place in American agriculture. Schultz speaks of agriculture as a "declining industry".[3] American agricultural policy, however, does not attempt to develop a large protective system. Economists and politicians rather try to bring the agriculture, increasing technology, rationalization, education, through research and extension services on a competitive level with other industries. This problem of displacement of labor is directly related to the method of substitution. Since the method of substitution is a means to apply and explain the principle of diminishing returns, it is necessary to find out where adjustments have to be made. Forster in his book Farm Organization and Management discusses the method of substitution and the necessary information to a successful application of the method.[4]

He points out the necessity of the knowledge of the extent and condition of the available farm resources, the normal basic material and labor requirements for production, and the normal yield or output of various farm enterprises. However, to handle the whole problem adequately, cost studies are undoubtedly necessary. Bennett in his Farm Cost Studies in the United States gives a wide scope of farm cost studies, their useful-

---

[3]Theodore W. Schultz, "Changes in Economic Structure Affecting American Agriculture", Journal of Farm Economics, XXVIII No. 1 (February, 1946), p. 15.

[4]G. W. Forster, Farm Organization and Management, pp. 81-95.

ness and applicability.[5] Following along this line, the problem leads to the study of input-output relationships in different enterprises. This problem is one of the oldest questions of controversy in agricultural economic studies. Recognizing the relationship between the input of fertility elements and the output of yields Justus von Liebig developed the concept of "the law of the minimum".[6] Meanwhile Turgot and von Thunen had already recognized these relationships in the law of diminishing returns. Mitscherlich elaborated this vaguely stated principle and made a first approach to the law of diminishing returns. Rippel and Meyer elaborated Mitscherlich's mathematical formulation of the principle, and stated that the presuppositions to mathematical formulations were not yet available. They pointed out that the law of returns is the relationship between all negative and positive influencing factors which contribute to the product and the actually obtained production or in terms of money, the gross income.[7] In the United States Spillman and Lang elaborated the law of diminishing increments and the law of the soil in citing results of fertilizing and feeding experiments.[8] In their procedure they refer largely to Mitscherlich's mathematical formulation. Spillman finally

---

[5] M. K. Bennett, "Farm Cost Studies in the United States."

[6] F. Honcamp, "Handbuch der Pflanzenernahrung und Dungerlehre", Erster Band Pflanzenernahrung, pp. 602-621.

[7] Ibid., pp. 607-616.

[8] Spillman and Lang, The Law of Diminishing Returns, et passim.

stated the problem as follows:

> "In man's struggle to wrest from nature ever more and more benefits, we also stumble upon facts of nature which tend to obstruct the customarily victorious course of man in this struggle, facts which do not indeed stand in the way as insurmountable barriers, but which nevertheless do constitute obstacles ever more and more difficult to overcome. We recognize such a principle, to be observed generally in nature in the 'Law of Diminishing Soil Returns.'"[9]

One of the most outstanding studies concerning input-output relationships has been written by Black in his book Introduction to Production Economics[10]. Black discusses in part three "the elements of production and their combination." He defines efficiency as "net output per unit of input," and capacity as "power to receive, hold or absorb." He states: "Capacity times efficiency equals productivity", and that the best combinations are made by associating the most efficient factors with the most efficient, and high-capacity factors with others of high capacity.[11] If capacity times efficiency equals productivity and efficiency is average output per unit, then capacity must be the number of units, and of course, the number of units times the average output per unit equals the total output.

Peterson says:

> "Economic theory is to a considerable extent based upon a marginal analysis of the effect upon output of changes in the proportion of the factors of production."[12]

---

[9] Ibid., p. 84.

[10] John D. Black, Introduction to Production Economics, pp. 275-478.

[11] Ibid., pp. 355-357.

[12] Peterson, Op. Cit., p. 59.

Since the points of emphasis in this study lie in the changes of returns and their consequences imputed to the production factors, land, labor, capital and management, the problem will be looked upon in retrospect from visible results. The analysis of the effective changes, which have taken place over a certain period through elaborating the shares of gross income imputed to land, labor, capital and management, may give some valuable trend indications in substituting one production factor for another. This problem is discussed in a study made by Heady: "Changes in income distribution in agriculture with special reference to technological progress."[13] Another study which touches indirectly the problem of substitution has been made by Brewster.[14] Brewster looks at the problem from another angle, and points out that American agriculture becomes more and more dependent upon full-employment in the economy as a whole. About the substitution Peterson says:

> As long as a gain can be made from substituting one factor for another, the producer who fails to take advantage of such an opportunity may be said to have an opportunity cost.[15]

Or for the problem viewed in a large area, Peterson says:

> "..... 'comparative advantage' is used to describe the application of the law of diminishing returns to the proportions in which the factors of production tend to

---

[13] Earl O. Heady, "Changes in income distribution in agriculture with special reference to technological progress," Journal of Farm Economics, XXVI (August, 1944), 435-447.

[14] John M. Brewster, "Farm Technological Advance and Population Growth," Journal of Farm Economics, XXII (August, 1945), 509-525.

[15] Peterson, Op. cit., p. 73.

be combined in order to produce the best result in two or more areas at the same time."[16]

It would be very interesting to extend the following study to the problem of economic diminishing returns. But the present investigation will be limited to the determination of the shares of gross income imputed to land, labor, capital and management.

---

[16]Ibid., p. 74.

III. AREA STUDIED

Heady's study, "Changes in income distribution in agriculture with special reference to technological progress" which later will serve as a comparison to this particular study in Garfield County, does not mention climatological and economical peculiarities of the area covered. Since this study covers only a local area, it may be of value to enumerate some of these important physical factors which affect the farming pattern of an area and indirectly the possibility of technological changes. The climate and the economical circumstances in the area studied stimulated the expansion of the wheat crop. Wheat farming facilitates the introduction of technological changes and therefore changes in the distribution of gross income to the production agents may occur more rapidly and in different rates than in general farming.

1. Location.

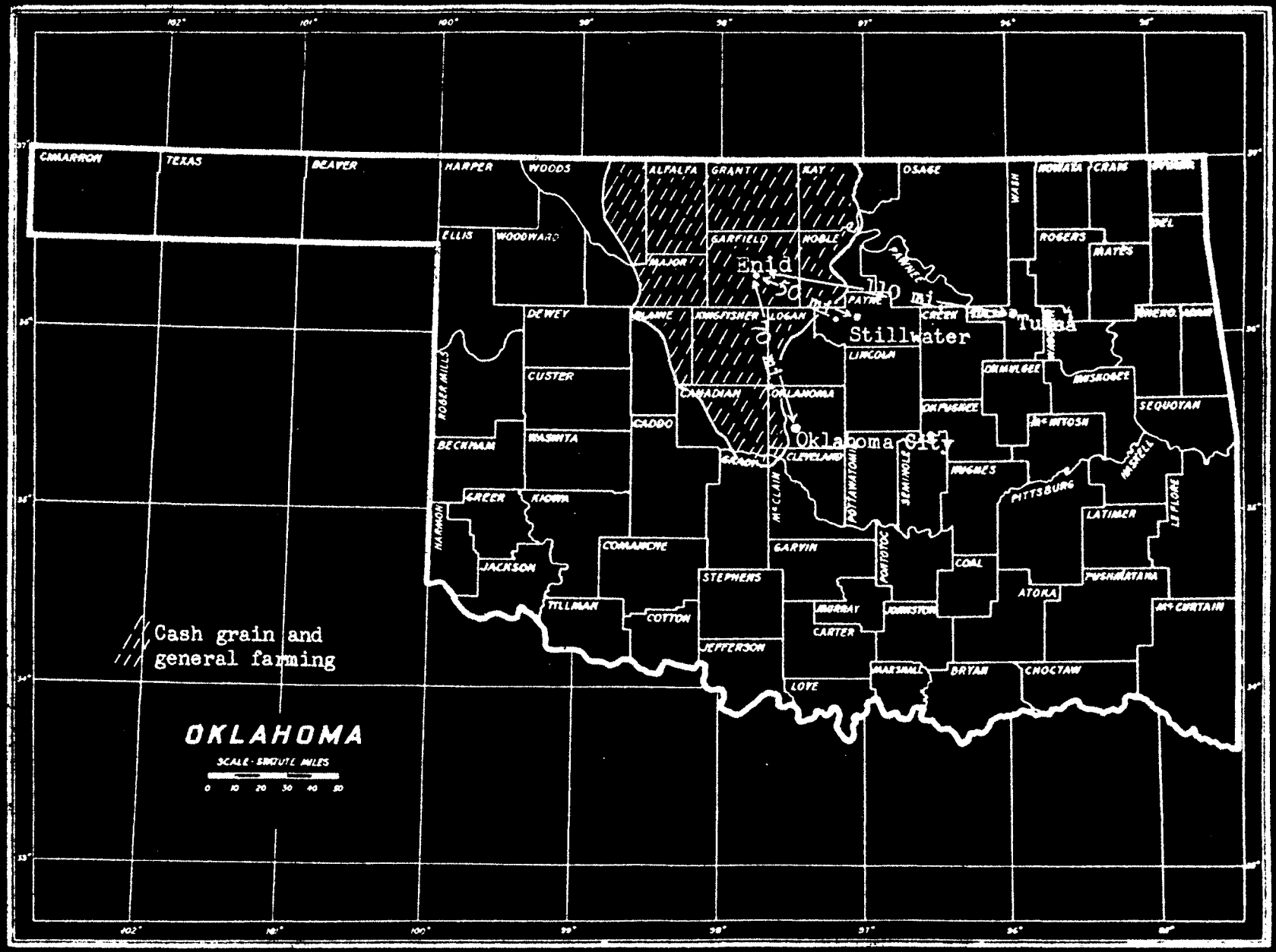
One of Oklahoma's counties with the highest proportion of wheat production is Garfield. (Fig. 1) It is separated from the first ranking wheat production state, Kansas, by Grant County. Approximately 70 miles northwest of Oklahoma City, 110 miles west of Tulsa and 50 miles northwest of Stillwater is the county seat, Enid. According to the Federal Census, 1940, Enid had a population of 28,061.[1]

> "The county is rectangular in outline and has an area of 1,049 square miles, or 671,360 acres. The principal

---

[1] The United States Census, 1940, Population Volume, I pp. 871-873

Figure 1. Situation of Garfield County in Oklahoma.



> physiographic divisions of the county consist of two fairly smooth plains with an eastward or southeastward slope of approximately 6 feet to a mile."[2]

2. History.

In 1907 Oklahoma became a state. At the same time the counties were laid out. Here is what Fitzpatrick, Boatright, and Rose have to say about this particular county:

> "Garfield County is located in what originally was called the Cherokee Strip in Indian Territory. The Chisholm Trail, which later became famous as a route for the driving of cattle from Texas to the railroads at Wichita, Kansas, passed through this section. Ranch headquarters were established, and by the late seventies this was an important range country. The Cherokees decided they would derive revenue from the land and required cattlemen to pay rent for the range. This led to the organization of the Cherokee Strip Livestock Association to deal with the Indians. The Federal Government bought this land from the Cherokee Nation in 1893 and opened it to settlement at noon on September 16, 1893. The settlers were largely from Kansas, Texas, Missouri, and other Middle Western States. Most of them were white people whose ancestors originally came from northern Europe."[3]

3. Climate.

The climate as a fixed factor in production has a great influence on the production pattern and gross income of any area. Garfield County, in the northwestern part of Oklahoma, is situated in the zone of transition from the humid prairies to the semi-arid plains, or, more popularly expressed, in the Great Plains. According to the distinctly continental situation, characteristically wide fluctuations of temperature occur. During the years 1929 to 1946 the lowest temperature was recorded on January 18, 1930 with minus 14°F., the highest

---

[2]E. G. Fitzpatrick, W. C. Boatright and L. E. Rose, "Garfield County, Oklahoma," Soil Survey, p. 1.

[3]Ibid., p. 5.

temperature on August 12, 1936 with 118°F. (Table I). The average annual temperature observed at the Enid weather station is 59.3°F. However, the period 1929 to 1946 shows only two years with a temperature below the mean. Sixteen years show a temperature above the annual mean. (Table III). The annual temperature for the last 18 years exceeds the average annual temperature by 1.6°F. The summers are decidedly warm, and often hot southerly winds scorch the vegetation. The winters are relatively mild. Numerous short cold periods, seldom lasting longer than three days, accompanied with strong northerly winds, suddenly lowered temperature, and, occasionally light rain or snow are very characteristic. This is most frequently the case in January, the coldest month of the year (Table I). The average frost-free season over the period 1929 to 1946 extends from March 29, to November 4, a period of 220 days (Table II). Parallel to the annual increase in temperature of 1.6°F., an increase of four days in length of the frost-free season has taken place compared with the average frost-free season over the period 1909 to 1930.[4] The longest frost-free season was 240 days, the shortest 197 days (Table II). Late frosts often destroy or seriously injure crops, such as fruits. The prevailing direction of the wind in Garfield County is from the S.W. (Table I). However, during the winter months, December, January and February, frequent short periods occur when the direction of the wind is from the north.

---

[4]A. Leonhard, The Cost of Producing Wheat in Garfield County in 1931, p. 6.

Table I. Temperature, Precipitation, Cloudy and Clear Days, and Prevailing Wind Direction in Garfield County, 1929 to 1946.

	Temperature in degrees Fahrenheit					Precipitation in inches					Number of days				Wind Direction
Yrs.	Annual mean	Highest	Date	Lowest	Date	Total for year	Greatest monthly	Mo.	Least monthly	Mo.	Total snowfall	*	Clear	Partly cloudy	Cloudy	
1929	58.3	106	Aug. 5	- 2	Feb. 9	33.09	10.58	May	0.02	Dec.	5.7	63	179	98	87	S
1930	60.8	106	Aug. 3	-14	Jan.18	25.23	5.45	May	0.08	Feb.	25.7	65	227	77	61	S
1931	62.1	106	Sep. 5	14	Jan.14	26.11	4.45	May	0.69	Dec.	18.0	75	197	95	72	S
1932	60.1	103	Aug. 1	2	Dec.12	37.97	12.80	Aug.	0.10	Nov.	7.7	69	203	97	65	S
1933	62.9	108	Jul. 2	- 6	Feb. 7	20.61	4.11	Aug.	0.26	Feb.	1.5	63	224	82	59	Se
1934	62.4	111	Jul.31	8	Feb.26	22.67	4.98	Sep.	0.25	Jul.	0.6	71	210	89	65	S
1935	60.4	109	Aug.11	- 2	Jan.21	24.06	5.84	May	0.59	Jul.	1.2	76	160	97	107	S
1936	62.0	118	Aug.12	- 2	Feb. 8	16.92	5.67	Sep.	0.00	Mar.	2.2	52	206	95	65	S
1937	59.9	112	Aug. 9	4	Jan. 8	30.24	6.73	Aug.	0.40	Feb.	8.4	72	170	110	85	S
1938	62.4	104	Aug.10	8	Jan.31	34.58	7.28	May	0.23	Jan.	19.3	71	178	123	64	S
1939	62.8	109	Jul.21	6	Feb.21	24.43	6.04	June	0.09	Sep.	16.9	56	204	101	59	S
1940	59.0	105	Aug. 3	1	Jan. 8	28.05	5.28	Nov.	0.10	Mar.	5.0	73	132	192	42	S
1941	60.4	106	Jul.18	17	Jan.18	49.40	15.70	Oct.	0.42	Mar.	1.0	101	108	121	136	S
1942	59.9	102	Aug. 2	- 1	Jan. 5	35.54	7.95	Apr.	0.08	July	31.1	91	174	105	86	S
1943	60.6	108	Aug. 9	- 5	Jan.19	25.93	8.24	May	0.09	Jan.	11.9	62	201	94	70	S
1944	60.8	106	Aug.13	8	Jan. 9	33.87	5.83	Nov.	0.78	Jan.	5.4	71	171	104	91	S
1945	59.6	104	Aug.18	6	Dec.19	29.15	7.36	Sep.	0.00	Nov.	7.5	86	176	111	78	S
1946	62.6	104	Jul.14	8	Dec.29	25.19	3.54	Sep.	1.09	July	0.8	72	184	117	64	S

* Precipitation, 0.01 inch or more

SOURCE: United States Department of Agriculture Weather Bureau. Climatological Data. Oklahoma Section 1929 to 1946.

Table II. Last and First Killing Frost in Garfield County, 1929 to 1946.

Years	Last of Spring	First of Autumn	Length of frost-free season
	(Date)	(Date)	(Days)
1929	March 17	Oct. 24	221
1930	March 30	Nov. 6	221
1931	April 20	Nov. 30	224
1932	March 22	Nov. 11	235
1933	March 23	Nov. 8	230
1934	March 27	Nov. 22	240
1935	March 17	Nov. 5	233
1936	April 6	Oct. 27	204
1937	April 5	Nov. 16	225
1938	April 9	Oct. 23	197
1939	April 7	Oct. 31	207
1940	April 12	Nov. 11	213
1941	March 29	Nov. 12	228
1942	March 31	Oct. 26	209
1943	March 22	Oct. 27	219
1944	March 30	Nov. 21	236

SOURCE: United States Department of Agriculture Weather Bureau. Climatological Data: Oklahoma Section, 1929 to 1946.

Table III. Annual Temperature and Precipitation and Departure in Garfield County, 1929 to 1946.

Years	Annual Temperature	Departure	Annual Precipitation	Departure
	(Degrees)	(Degrees)	(Inches)	(Inches)
1929	58.3	- 1.0	33.09	+ 2.29
1930	60.8	+ 1.5	25.23	- 5.57
1931	62.1	+ 2.9	26.11	- 4.69
1932	60.1	+ 0.8	37.97	+ 7.53
1933	62.9	+ 3.6	20.61	- 9.83
1934	62.4	+ 3.1	22.67	- 7.77
1935	60.4	+ 1.1	24.06	- 6.38
1936	62.0	+ 2.7	17.73	-13.36
1937	59.9	+ 0.6	30.24	- 0.42
1938	62.4	+ 3.2	34.58	+ 3.92
1939	62.8	+ 3.5	24.43	- 6.23
1940	59.0	- 0.3	28.33	- 2.33
1941	60.4	+ 1.1	40.29	+ 9.63
1942	59.9	+ 0.6	35.54	+ 4.88
1943	60.6	+ 1.3	25.93	- 4.73
1944	60.8	+ 1.5	33.87	+ 3.21
1945	59.6	+ 0.2	29.15	- 0.67
1946	62.6	+ 3.1	25.19	- 4.63

SOURCE: United States Department of Agriculture Weather Bureau. Climatological Data: Oklahoma Section 1929 to 1946.

The annual precipitation over the period 1929 to 1946 averaged 28.61 inches. The lowest precipitation of 17.73 inches occurred in 1936, the highest of 40.29 inches, in 1941 (Table I). According to the annual temperature increase and the extension of the frost-free season, the 18 year period sums up a rainfall deficit of 35.15 inches, a little more than one year average. This is as much as 5.5 percent decrease in precipitation.

In response to the low annual precipitation and the drought periods, the choice of crops in this section is limited to those which are able to withstand drought conditions. For this reason, the most important crop is winter wheat.

4. Soils.

Most of the soils in Garfield County are medium textured and comparatively fertile.

> "Most of the soils are fairly well supplied with the plant nutrients necessary for the production of crops. Addition of commercial fertilizers, manure, or lime generally are unnecessary and in some instances, may be detrimental if moisture conditions are unfavorable.--Nitrogenous fertilizers and manure on the medium textured soils sometimes reduce yields by inducing rapid growth which exhausts the supply of moisture early in the season."[5]

Throughout the country heavy subsoils are prevalent. Therefore, the moisture, upon which the success in farming in this section is most dependent, moves slower in the heavier textured subsoils, which is most favorable to the plants. During the relatively dry winter months, the wheat in its semidormant condition has a constant source of moisture. The top soils

---

[5]E. G. Fitzpatrick, W. C. Boatright and L. E. Rose, Op. cit., pp. 11-12.

range from a depth of six to twenty inches, and are generally brown, dark brown, or grayish brown and largely of a very fine sandy loam and silt loam texture. The soils of the county are placed in the following groups on the basis of soil character:

> (1) Brown Prairie soils with friable subsoils, (2) brown Prairie soils with dense heavy subsoils, (3) reddish-brown Prairie soils with friable subsoil, (4) red Prairie soils with both heavy and friable subsoils, (5) grayish-brown sandy soils with very friable subsoils, (6) brown soils with saline subsoils, (7) alluvial soils, and (8) miscellaneous nonarable land.[6]

The soils in Garfield County are well supplied with all plant nutrients; they have a high virgin fertility. However, there is not adequate annual precipitation, to make use of the soils at the full capacity of their stored-up fertility. Once this virgin fertility has been abused to the point where fertility maintenance through fertilizing has to begin, the low annual precipitation sets limits in the quantity of fertilizer application.

5. Economic Situation of Garfield County.

With the development of new transportation facilities such as railroads, truck lines, and air routes, the distance between market centers and producing centers such as the Great Plains becomes shorter and shorter.

Enid, the county seat, is the trade center, with a large consumer and shipping center. Since this county is agricultural, rather than industrial, most of its industries are directly related to the processing, shipping and utilization of agricultural

---

[6] Ibid., p. 13.

products. Establishments of this type are flour mills, feed mills, creameries, milk condenseries, poultry packing plants, meat packing plants, bakeries, broom factories, and mattress factories.

The county is well provided with railroads and highways. The paved United States Highways Nos. 60, 64, and 81, cross the county. Radiating from Enid are 10 lines of the Chicago, Rock Island and Pacific Railway, the St. Louis-San Francisco Railway, and the Atchison, Topeka and Santa Fe Railway. All these and other exceptionally good marketing facilities aid the flow of agricultural products such as wheat and the processed products to the marketing centers. As time goes on the law of localization is losing its importance and its influence in the farming system. Also areas of remote economic location may increase their production intensity in proportion to the declining influence of transportation and trade barriers.

IV. ORGANIZATION OF GARFIELD FARMS

1. Number and size of farms.

In determining the share of gross income imputed to land, labor, capital and management, the size of the operated firm plays a very important role. Smaller and diversified farms usually have a higher proportion of labor input than larger and more specialized farm units. The census data of the state of Oklahoma and Garfield County, as well as the original data gathered from six record-keeping farms may give some valuable information. Table IV shows a total decrease in number of farms in Oklahoma from 203,866 in 1930 to 164,790 in 1945. This is a total decrease of 39,076 farms, or a decrease of 19.17 percent. The number of farms 10 to 259 acres in size are rapidly decreasing; those 260 up to 10,000 acres and over are increasing. The six analyzed farms averaging 422 acres in size in 1945 may therefore be more typical for the area than the average size farm of 249 acres. According to the development in the state, Garfield County (Table V) shows a decline in number of farms from 3,478 in 1930 to 2,634 in 1945 or 24.26 percent, which is a little above the average decrease in the state. During the same period the average size of all Garfield farms increased from 204.2 acres to 248.8 acres or 21.84 percent. The six observed farms show an increase in size from 251.6 acres in 1930 to 422.1 acres in 1945 or an increase of 67.76 percent.

This striking change in farm size over the last 15 years indicates clearly the ability of the farm operators to handle increasingly larger size units. The question arises: What are

Table IV. Farms by Size in Oklahoma 1930 to 1945.

Size Group	1945	1940	1935	1930
	(number)	(number)	(number)	(number)
All farms	164790	179687	213325	203866
Under 10 acres	15140	8709	7894	5271
10 to 29 acres	12064	13736	18090	*
30 to 49 acres	13536	17448	25827	*
50 to 99 acres	27401	36587	49078	48362
100 to 174 acres	*	54278	66809	64685
100 to 179 acres	44579	54763	67339	*
175 to 259 acres	*	16404	16743	17565
180 to 259 acres	15486	15919	16213	*
260 to 499 acres	24752	22755	21162	20704
500 to 999 acres	8310	6979	5647	5490
1000 acres and over	3522	2791	2075	1833
10,000 acres and over	100	85	79	80

SOURCE: United States Department of Commerce, Bureau of the Census; Census of Agriculture 1930, 1935, 1940, 1945.

* Not available

Table V. Number and average size of farms in Garfield County.

	1945	1940	1935	1930	Relative increase or decrease over the period 1930-1945
Farms, number *	2634	2900	3056	3478	- 24.26
Average size, acres	248.8	223.2	213.5	204.2	+ 21.84
Average size of the 6 analyzed farms, acres	422.1	361.6	283.3	251.6	+ 67.76

* United States Department of Commerce, Bureau of the Census; Census of Agriculture 1945, 1940, 1935, 1930.

the causes of such a trend in farm sizes? According to the more or less specialized farming pattern in Garfield County, the analysis of some physical changes such as the value of implements and machinery per farm and per acre, the number of horses, tractors and combines per farm and the number of family and hired workers per farm and per 100 acres of farm land during the last 15 years may help to explain the farm size change as well as changes in shares of gross income imputed to land, labor, capital and management.

2. Value of implements and machinery.

One of the most important farm management problems is the decision of how intensively or extensively implements and machinery should be used. The size of the firm, the general labor conditions as well as the technological development of farm implements and machinery are directly correlated. As Black says:

> "Production with capital goods developed because a given amount of labor produces more if part of it is used to make tools and equipment for the rest to work with."[1]

It is well known that the productivity of industrial workers has increased considerably, due to technological advances. But what about the productivity of the agricultural worker? As shown in Table X the number of family and hired workers per 100 acres in Garfield County has decreased from 0.886 in 1930 to 0.699 in 1945 or by 12.68 percent. In addition, improved production methods and greater efficiency contributed to the

---

[1]John D. Black, Marion Clawson, Charles R. Sayre, Walter W. Wilcox, Farm Management, p. 521.

increase of productivity of the agricultural worker. Wilcox demonstrates the increase in output per worker as shown in Table VI.[2]

The increase in output per industrial worker amounts to 73 index points whereas agricultural workers show an increase of 64 points. Considering the decentralization and the high proportion of dynamic production factors in agriculture, this striking similarity to industry is surprising. A great proportion of this success is due to the intensive research by public institutions, and the development of new and better farm machinery by manufacturers.

The trend of value of implements and machinery in Garfield County, as shown in Table VII, indicates an increase in value for the average Garfield County farm from $1,217.18 in 1930 to $1,955.02 in 1945 and for the six analyzed farms from $2,345.33 to $3,295.00. The decrease in value of implements and machinery in 1935 may be due partly to the very low general price level during the depression years, and partly to the decline in new investments. These absolute figures shown in Table VII and VIII may include some errors because they are not deflated to any standard period. However, since the farmers tend to record general agricultural values rather than extreme market values, this weakness may not be of great significance. The value of implements and machinery per acre shows for the average Garfield farm an increase from $5.96 in 1930

---

[2]Walter W. Wilcox, The Farmer in the Second World War, p. 287.

Table VI. Production Per Employee in Agriculture and Industry

Year	Production Per Employee (1910 to 14 = 100) Agriculture	Industry
1930	127	150
1935	120	146
1940	151	180
1945	191	223

SOURCE: United States Department of Agriculture, Bureau of Agricultural Economics. 1946 Agricultural Outlook Charts, Dec. 1945.

Table VII. Value of implements and machinery.

Year	Garfield farms (Average) *	Six analyzed farms (Average)
	(Dollars)	(Dollars)
1930	1217.58	2345.33
1935	**	1482.50
1940	1338.80	3104.66
1945	1955.02	3295.00

* United States Department of Commerce, Bureau of the Census; Census of Agriculture 1930, 1940, 1945

** Not available

Table VIII. Value of implements and machinery per acre.

Year	Garfield farms (Average) *	Six analyzed farms (Average)
	(Dollars)	(Dollars)
1930	5.96	9.32
1935	**	5.23
1940	6.00	8.59
1945	7.88	7.81

* Data obtained by dividing average investments in implements and machinery by the average size of Garfield farms.

** Not available

to $7.88 in 1945 (Table VIII). The corresponding value on the six analyzed farms shows a decrease per acre from $9.32 to $7.81. This discrepancy in value of implements and machinery between average Garfield farms and the specifically analyzed farms is explained by the different rate of increase in farm size (Table V). Whereas the increase in farm size for the average farm may not offset the increase of value of implements and machinery per acre, the increase of the size of the six analyzed farms even decreases the value of implements and machinery on a per acre basis. This fact may serve as an indication that the six analyzed farms probably use their implements and machinery more efficiently than the average Garfield farms. This may also indicate that the most efficient size of the firm in this specific area is not yet reached.

3. Horses, tractors and combines per farm in Garfield County.

Another common indicator of physical changes in farming is the structure of the power supply. Black says:

> "Much of the history of modern agriculture can be written in terms of its machines.... In 1910, the power on the farms of the United States was supplied by 19,972,000 horses and 4,239,000 mules; in 1943 by 9,678,000 horses, 3,712,000 mules, and 1,906,000 tractors."[3]

This tremendous shift from animal to mechanical power has also changed the nature of the farm work. Operators as well as workers need mechanical skill. This change is not only characteristic of the United States but also of the average farm in Garfield County and especially of the six analyzed

---

[3]John D. Black, Farm Management, p. 525.

farms. Table IX indicates that the use of horse power on the average farm in Garfield County decreased during the period 1930 to 1945 by 1.12 units, whereas the use of tractor power increased by only 0.08 units. This slight increase in the use of tractor power, compared with the considerable decrease in the use of horse power would indicate that the average farm of 1945 is able to use the tractors more efficiently than in 1930; or in other words, the new tractor models probably have a higher efficiency. The six analyzed farms relied heavily in 1930 on horsepower with 4.67 horse units per farm. In 1945, the picture was entirely changed: 0.83 units of horses and 1.83 units of tractors supplied the power needs per farm. This change in power supply is probably directly related to the more rapid increase in farm size of the farms analyzed than in the average run of farms. In 1940, five of the six farms used combines; in 1945, every other one of the six farms owned two combines. The introduction of combines on the majority of wheat producing farms has decreased and in many cases eliminated the army of laborers that customarily move across the United States and Canada during wheat harvesting. With the use of combines, pick-up balers, and corn-pickers, much of the work which formerly needed hired labor is done by the operator and his family.

Table IX. Number of horses, tractors and combines per farm in Garfield County.

	Average farm in Garfield County.*			Average of the six analyzed farms.**		
Years	Horses	Tractors	Combines	Horses	Tractors	Combines
	(Number)	(Number)	(Number)	(Number)	(Number)	(Number)
1930	4.03	1.11	***	4.67	--	0.00
1935	3.91	***	***	3.33	1.00	0.00
1940	2.80	1.10	***	1.33	1.17	0.83
1945	2.91	1.19	***	0.83	1.83	1.50

* United States Department of Commerce, Bureau of the Census; Census of Agriculture, 1930, 1935, 1940, 1945.

** Data out of actual farm records.

*** Not available.

4. Labor.

It is well known that the proportion of working population engaged in agriculture is generally decreasing. In the United States the proportion decreased from 21.6 in 1930 to 15.0 in 1944.[4] This is a relative decrease of 31 percent. In Garfield farms the decrease during the period 1930 to 1945 amounts only to 0.07 labor units per farm or 0.40 percent (Table X). However, Garfield farms increased in size during the same period by 21.84 percent. Figuring the labor decrease on a per acre basis there is a 21.10 percent decrease in labor units. Looking upon the decrease of labor units in the United States as a whole, Garfield County shows one third less. However, this conclusion may not be justified because Garfield farms in 1930 were about three times as capital intensive, but only half as labor intensive as the United States average farms. This may explain the relatively smaller decline in labor units per farm in Garfield County than in the United States.

Schultz in his study "Changes in Economic Structure Affecting American Agriculture" relates to a large extent the problem of changes in employment and its effect on output and labor efficiency.[5] In this paper Schultz answers the following question: Is American agriculture a declining industry? He says:

---

[4]Theodore W. Schultz, Agriculture in an Unstable Economy, p. 87.

[5]Theodore W. Schultz, "Changes in Economic Structure Affecting American Agriculture," Journal of Farm Economics, XXVIII No. 1 (February, 1946), 15-27.

Table X. Family and hired workers per farm and per 100 acres in Garfield County.

	1930	1935	1940	1945	Decrease
	(Number)	(Number)	(Number)	(Number)	(Percent)
Family and hired workers per farm (average)*	1.81	1.88	1.64	1.74	0.40
Family and hired workers per 100 acres farm land in Garfield County.**	0.886	0.880	0.734	0.699	21.10

* Figures obtained by dividing the number of family and hired workers with the number of farms reporting. United States Department of Commerce, Bureau of the Census; Census of Agriculture 1945, 1940, 1935, 1930.

** Figures obtained by the following operation: $\frac{\text{Worker per farm} \cdot 100}{\text{Average size of farm}}$

"The answer is yes in one significant sense: It takes, in absolute terms, less and less human effort to produce all of the farm products demanded by the economy served by American agriculture. The crucial fact is that fewer people are needed in farming, even with full employment, high incomes and large exports, and this is true despite the large natural increase of the farm population. This decline in the labor force in farming does not mean that agricultural production is decreasing or is likely to do so. Nor does it mean that the demand for farm products is falling; the contrary is true when income and population increase."[6]

Schultz supports his answer with the following figures:

"1. The expansion in agricultural output occurred at a much slower rate than that in other major industries, namely--[7]

		Increase in output
Agriculture	(1900 to 1939)	60 per cent
Mining	(1900 to 1939)	240 per cent
Manufacturing	(1900 to 1939)	267 per cent
Public utilities	(1899 to 1939)	310 per cent

"2. The increase in production per worker was quite similar in agriculture and in other major industries, namely--[8]

		Decrease in Employment per unit of product
Agriculture	(1900 to 1939)	48 per cent
Mining	(1902 to 1939)	61 per cent
Manufacturing	(1899 to 1939)	50 per cent
Public utilities	(1899 to 1939)	50 per cent

"3. These increases in output and the increases in labor efficiency resulted in a decline in employment in agriculture and in an expansion in other major industries, namely--[9]

---

[6] Ibid., p. 17.

[7] From Solomon Fabricant, Labor Savings in American Industry 1899-1939, Occasional paper 23. National Bureau of Economic Research. Appendix tables, quoted in Schultz, Loc. cit.

[8] Ibid., p. 18.

[9] Schultz, Loc. cit.

		Decreases and increases in labor force
Agriculture	(1900 to 1940)	- 18 per cent
Mining	(1900 to 1940)	+ 37 per cent
Manufacturing	(1900 to 1940)	+ 92 per cent
Public utilities	(1900 to 1940)	+ 105 per cent
Other industries	(1900 to 1940)	+ 209 per cent."

The causes of these changes cited may be numerous. Schultz sees the decline of agriculture as follows:

> "The demand for farm products rides on a low tide--the result of the slowing down of the growth of population and the low income elasticity of farm products. The supply of farm products, however, rides on a high tide, swollen by technological advances. Out of the interaction has come the significant fact that a declining amount of human effort is required to produce all of the farm products demanded by those who depend on American agriculture for food, feed and fiber."[10]

However, the increase in output in agriculture could never proceed at the same rate as that of industry, even if the demand for agricultural products were to increase at the same rate as the demand for industrial products. The agricultural output has some rigid limits in the form of natural conditions such as climate, soil fertility, and the productiveness of plants and animals. It is characteristic of agriculture that the above cited increase of 60 percent in output has been achieved by an 18 percent decrease of labor forces. This increase in output may be due largely to improved production methods and higher efficiency in the use of the production factors. Only a small proportion may be attributed to higher yielding breeds.

---

[10] Ibid., p. 19.

Another study which may be ranged under "labor" has been made by Brewster, and may be summarized as follows:

> "A progressive farm technology as such provides a solid mechanical basis for a system of well operated family farms. But as total population increase becomes slower than farm technological advance, the future of well-operated family units has come to rest increasingly upon a new social requirement--a full employment economy with alternative outlets for an occupationally declining agriculture."[11]

Brewster indicates that American agriculture with declining employment, and increasing capital and management combined with farm size increase, becomes more and more dependent upon full employment in the economy. According to the general agricultural policy concept, American agriculture may in time grow up to a competitive industry equal to other industries. If this development continues, the per capita income derived from agriculture will increase, but the risk to run agricultural business will also rise.

---

[11] John M. Brewster, "Farm Technological Advance and Population Growth," Journal of Farm Economics, XXII (August, 1945) p. 525.

V. CHANGES IN INCOME DISTRIBUTION IN AGRICULTURE IN GENERAL AND FOR SIX SELECTED FARMS IN GARFIELD COUNTY

1. General Principles.

The distribution of income is largely determined by the amount of input of each production factor during the production process. Since war periods create increases in demand for agricultural as well as industrial products, price levels rise and production is stimulated. However, the drain of labor forces from agriculture to army and industry creates a labor shortage which stimulates the acquisition of additional capital or improved production methods combined with longer labor hours per worker. Very important, in such circumstances, are the educational activities of the Agricultural Extension Services. Only by increasing the managerial ability of the operators may shifts to new approved practices become effective. In discussing such a problem it may be of interest to analyze the distribution of the agricultural income to the production factors. Heady in his study "Changes in income distribution in agriculture with special reference to technological progress" states the problem as follows:

> "How does technological change affect the relative importance of the factors land, labor, capital and management and the share of agricultural income imputed to each?"[1]

Since Heady's study is generalized, and covers the United States, it can not be applied precisely to any specific area. This study proposes an analysis of Garfield County which may

---

[1] Earl O. Heady, Op. cit., p. 436.

by typical of a large segment of the western wheat-producing area of Oklahoma. Whereas Heady's study is based largely upon census estimates, the actual figures for this study are obtained from six record-keeping farms in Garfield County. In a more or less specialized area such as Garfield County in which 75 percent of the cropland is planted in wheat, the small number of farms analyzed may, nevertheless, give adequate trend indications in the distribution of gross income. However, the results must be interpreted very cautiously and should not be generalized or applied to a large area even with similar characteristics without recognizing this weakness. By extending this analysis over a greater number of farms, a more conclusive study would have resulted. But the extent of coverage was limited by the lack of complete records for the period studied.

As shown in the preceding chapter, the increase of technological developments during the last 20 years has brought about considerable change in farm organization. However, its economic influence upon the agricultural firm and the relative importance of her production factors have not been analyzed for local areas. As Heady says:

> "A technological change often has the effect of changing the relative importance of agents used in the production of a given commodity. Accordingly, either or both the absolute and relative shares of the product imputed to the factors used may be altered. This is as true in agriculture as elsewhere and may give rise to numerous income and organizational problems in the industry; it is a problem which thus far has received little attention by agricultural economists."[2]

---

[2] Ibid., p. 436.

The proportion of the factors and their importance in the production process change from enterprise to enterprise and from farming system to farming system. A highly diversified and mainly self-sufficing farm may have a larger ratio of labor input than a specialized farm.

How do technological changes affect the income imputed to a given factor? Heady says:

> "(1) Both the absolute and relative shares of the product imputed to a given factor may be decreased. (2) Both absolute and relative shares may be increased. (3) The absolute share may increase while the relative share is decreased. The final outcome depends on how the marginal productivity of the given factor is affected."[3]

An important question to raise in this connection is: What is meant by the expression "technological change"? What do we consider as a technological change? There is no exact definition. However, in following Heady's example, one distinguishes between labor saving, capital saving or neutral inventions.[4] The effect of inventions is measured by the increase or decrease of the marginal-productivity of the factor in consideration. Technological changes in agriculture are so interrelated with the production factors used that the specific effect on returns attributable to any given change is difficult to determine. In considering the effects of such changes on the shares to the various factors in agriculture, the customary demarcation of land, labor, capital and management has been made. A comparison of absolute shares of gross

---

[3] Ibid., p. 437.

[4] Heady, Loc. cit.

income to these factors over several years would be meaningless, since the gross income is largely dependent upon general demand and supply conditions and the resulting commodity price levels. In addition, numerous other economic forces are influencing agricultural gross income. Heady says:

> "The effect of these outside forces on agricultural prices alone should mainly be reflected in the absolute and relative shares going to factors which have no alternatives other than farming. Factors which are freely mobile and enjoy close alternatives in other industries would gain or lose only temporarily from price changes affecting agriculture alone. Were the supply of factors in an industry absolutely fixed, commodity price changes would not alter the absolute and relative shares of physical product nor the relative shares of money income imputed to any one factor. Accordingly, to the extent that land is the fixed factor in agriculture the effect of forces outside the field of technological change on agricultural price should be reflected in the absolute share of agricultural income imputed to land."[5]

However, Heady points out that there is not complete freedom of entry or exodus for labor and capital in agriculture on a basis of comparative returns in other industries. He says:

> "Only to the extent that labor and capital are mobile in the long run do 'outside' price changes effect the relative share of gross income paid to each factor."[6]

The significance of the problem as a whole lies in the consequences of changing relative shares of income to the production factors in agriculture. Therefore it makes no difference how much of the change is due to technological or outside forces.

---

[5] Ibid., pp. 438-439.

[6] Ibid., p. 439.

2. Source of data and method of analysis.

In order to obtain comparative figures, essentially the same method was used in summarizing the data, as Heady used. However, Heady's findings are supported by estimates, whereas the figures used for Garfield County were obtained from farm records dating back to 1929. In computing relative shares, the absolute shares have to be gathered for each year under consideration. In the case of land, Heady's estimate is based on gross rents paid landlords, and the proportion of the value of all land and improvements operated under rental arrangements. In this study the absolute share imputed to land is based on the customary rent paid to landlords of one third of crop and feed plus cash rent, if any. This assumes that if rental rates have been determined competitively, the rents paid represent the marginal product of the land. In the case of labor, the rate of returns is obtained by adding the actual paid wages for hired labor plus the reckoned value of family and operator labor. The value of family and operator labor is assumed as equivalent to hired labor. Concerning capital and management Heady says:

> "There exists no satisfactory method of separating the approximate share imputed to capital from that of management."[7]

The figures obtained from actual records as well as Heady's estimates include some subjective weaknesses. For example, some family labor for which a certain amount is shown in the

---

[7] Ibid., p. 440.

account records, would not be used if a wage actually had to be paid. Not only economic reasoning is determining the use of production factors, but also subjective preferences of the farm operator.

About rents Heady says:

> "Rents paid to landlords are slow in adjusting to new conditions and include not only a payment for the use of the land but is also a partial payment for the use of some capital, especially in the form of improvements."[8]

When Heady speaks of slow adjustments of rents to new conditions, he probably is thinking primarily of cash rent and only secondarily of share rent. It is true that cash rent responds relatively slower to changed conditions than share rent. In times of rising prices this may be to the advantage of the tenant, whereas in price declining periods the landlord will have the advantage. Share rents respond directly to changed price conditions, different yields, improved production methods, and the introduction of higher yielding breeds. However, share rent does not respond directly to technological advances, which may lower the production costs but do not influence the yield of a crop.

The returns to land include a payment for improvements. In a study of this type this may not be especially significant since improvements do not represent the type of capital which has undergone the most important technological changes, and the returns to improvements generally will not amount to more than one fifth or one fourth of the share to land.

---

[8] Ibid., p. 441.

3. Relative shares of gross income imputed to land, labor, capital and management.

The trends of shares imputed to land, labor, capital and management are shown in Table XI and Fig. 2. The returns to land show a clear tendency to increase. The lowest share to land was found in 1930 with 14.07 percent of gross income; the highest share, in 1946 with 21.57 percent. Since the share to land represents its marginal product, an increase in the marginal productivity of the land in Garfield County is obvious.

The figures show a definite decline in the importance of the labor factor in agriculture. This decrease in relative share to labor from a high point of 33.46 percent of gross income in 1930 to a low point of 13.06 percent in 1946 supports the earlier statements about the labor decline in agriculture.

The returns to capital and management show an increase in the early thirties, but tend to be more or less stable since 1934. This may be explained by the fact that while the size of the firm in the observed area was steadily increasing, the value of implements and machinery on a per acre basis was only slightly increasing, and for the analyzed farms, even decreasing. Since the amount of capital invested in implements and machinery is the major part of the capital, this decrease of value on a per acre basis may indicate that the increase of returns to capital and management is rather due to increased managerial activities.

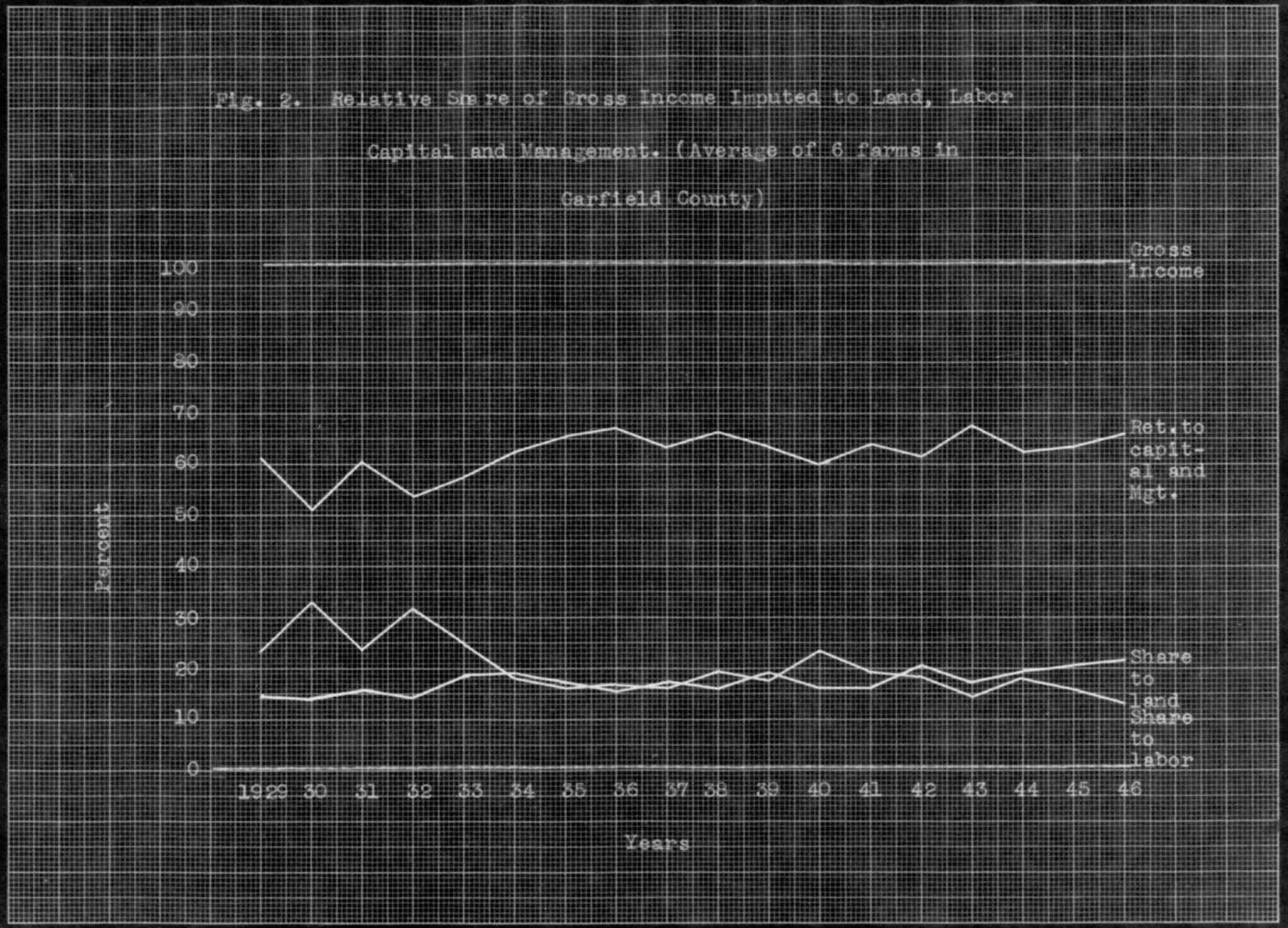
Table XII shows averages of the relative figures during

Table XI. Relative shares of gross income imputed to land, labor, capital and management. (Average of 6 Garfield farms).*

Years	Land (Percent)	Labor (Percent)	Capital and Management (Percent)	Total Gross Income (Percent)
1929	14.90	23.90	61.20	100
1930	15.07	33.46	51.47	100
1931	15.37	23.76	60.87	100
1932	14.81	31.56	53.63	100
1933	18.41	24.24	57.35	100
1934	19.24	18.48	62.28	100
1935	17.90	16.92	65.18	100
1936	15.78	16.76	67.46	100
1937	18.19	17.38	64.43	100
1938	15.22	19.18	65.60	100
1939	19.03	17.20	63.77	100
1940	16.64	23.45	59.91	100
1941	16.50	19.52	63.98	100
1942	20.53	18.19	61.28	100
1943	17.65	14.81	67.54	100
1944	19.64	18.01	62.35	100
1945	20.36	16.20	63.44	100
1946	21.57	13.06	65.37	100

* Based on absolute shares for each year under consideration:
Land, customary rent paid to landlord plus cash rent if any.
Labor, actual paid wages for hired labor plus reckoned value of family and operator labor.
Capital and management, gross income minus absolute shares of land and labor.

Fig. 2. Relative Share of Gross Income Imputed to Land, Labor Capital and Management. (Average of 6 farms in Garfield County)



the depression period, 1929-1934, the recovery period, 1935-1940, with its numerous governmental activities concerning agriculture, and the war period, 1941-1946.

A comparison of the findings in Garfield County with Heady's figures, which represent an average for the United States, shows some interesting deviations. The period 1924-1928 in Heady's study will be compared with the data from the first available year, 1929, in the Garfield study. This comparison may be justified since the general agricultural situation was more or less stable from 1924 to 1929.

The relative shares of gross income to:

	Labor	Land	Capital and management
1924-28 (Heady)[9]	47.4	30.2	22.4
1929 (Garfield)	23.9	14.9	61.2

The marked discrepancy between these figures indicates that the United States average farm was about twice as labor intensive and that the land was used about twice as intensively in the late twenties as the farms in Garfield County. However, the farms in Garfield County combined approximately three times as much capital and management as the United States average farms. The ratio of 2 to 1 in returns to land shows that the marginal productivity of land in the United States average farms was about twice the marginal productivity of land in Garfield farms in 1929.

The next comparative period shows the following distribution

---

[9] Ibid., p. 440.

Table XII. Relative shares of gross income imputed to land, labor, capital and management over 3 periods. (Average of 6 Garfield farms).*

Years	Land	Labor	Capital and management	Total
1929-1934	16.01	26.05	57.94	100
1935-1940	17.00	18.50	64.50	100
1941-1946	19.37	16.63	64.00	100

* See footnote, Table XI.

of gross income:

	Labor	Land	Capital and management
1936-40 (Heady)[10]	41.8	26.9	31.3
1936-40 (Garfield)	18.73	16.88	64.39

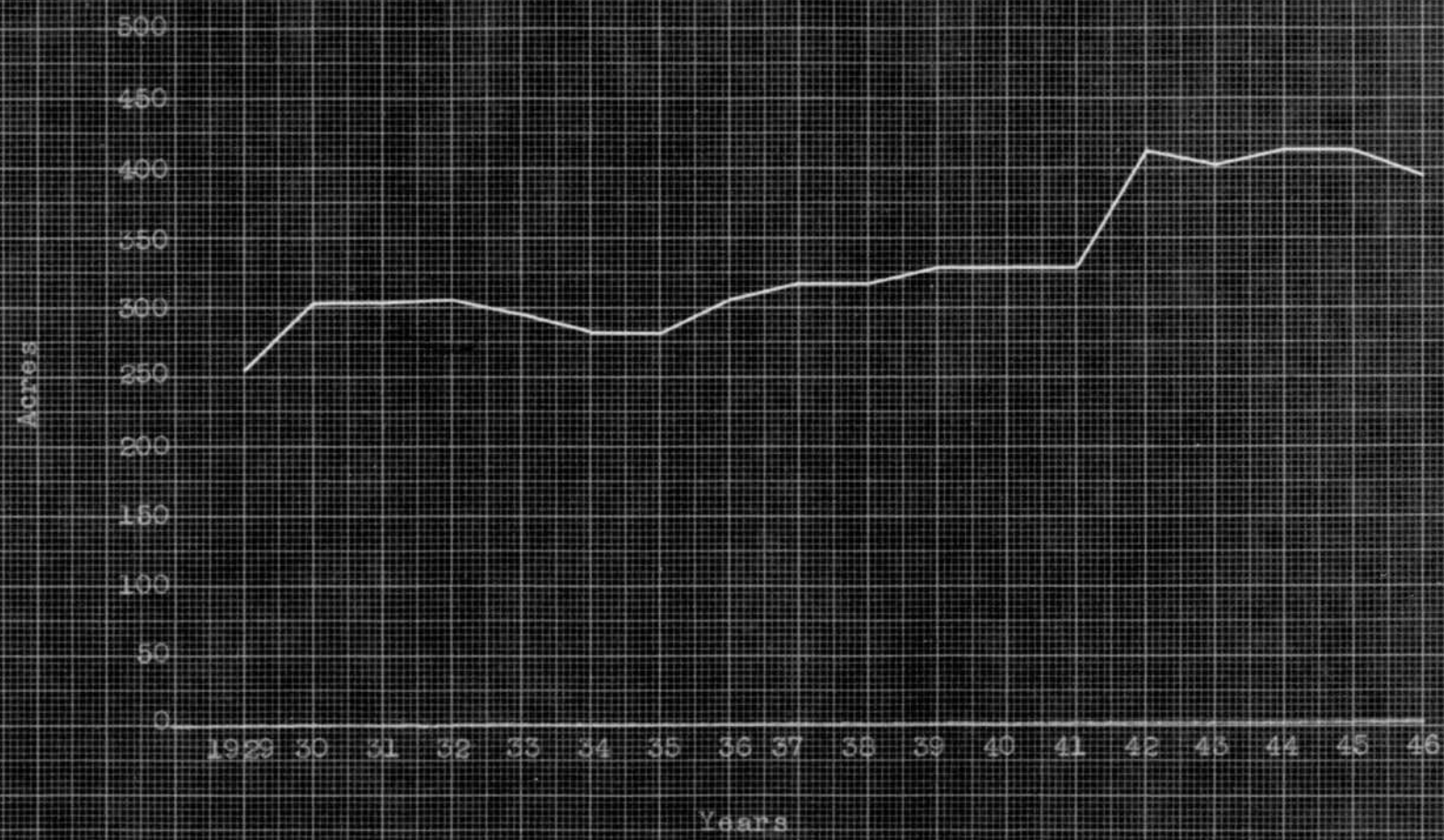
Comparing this period with the period 1924-1928 and the year 1929, the share to labor in the United States average shows a decrease of 11.81 percent, whereas in Garfield County, the same comparison shows a decrease of 21.10 percent. This relatively larger decrease in share to labor can be related to the higher degree of specialization and the consequent tendency to substitute machinery for labor.

The share imputed to land on the United States average farms decreased over the same period by 10.93 percent, whereas the Garfield farms show an increase of 18.25 percent. The decrease on the United States average farms plus the increase on Garfield farms equals a difference of 29.18. This seems to indicate that the marginal productivity of the land in Garfield County farms increased by approximately one third over the period 1924-1940. This also serves as an indication, that through various transportation facilities, increase in speed of transportation, and modern storage facilities, economically inaccessible areas such as Oklahoma become more and more accessible to the various market centers. This would also support Heady's statement that forces outside the field of technological change should be reflected in the share of agricultural income

---

[10]Heady, Loc. cit.

Fig. 3. Average size of 6 Garfield farms



imputed to land.

The share imputed to capital and management increased on the United States average farms by 39.73 percent, whereas on Garfield farms, only by 6.09 percent. As pointed out earlier, the size of the analyzed farms has increased considerably (Fig. 3). On a per acre basis, however, the capital investment shows a decrease. In addition it must be recalled that Garfield farms are much more capital intensive than the United States average farms. According to the increase in farm size, and the only slight increase of returns to capital and management, it may be safe to conclude that Garfield operators use their capital investments more efficiently than the United States average operators. The slight increase in returns to capital and management is due to increased managerial activities rather than to capital investments.

4. Significance of these changes.

The question which this paper attempts to answer is: How does technological change affect the relative importance of the factors land, labor, capital and management, and the share of agricultural income imputed to each?

In the case of land, Garfield County shows a considerable increase in its relative returns, and therewith in its marginal productivity. The major effects of outside forces should theoretically be capitalized into land.[11] Contrary to the United States average farm situation, signs seem to point to

---

[11] Ibid., p. 445.

an increasing importance of land as an input in Garfield County. Inventions which substitute labor, and at the same time increase the physical productivity of land, affect rents. A part of an increase in returns of this kind probably tends to be capitalized into the land. In speaking of reasons for increased returns to land Heady says:

> "Theoretically this growth in population (he means the growth of population in the United States) should increase both absolute and relative shares imputed to land. The fact that the relative share of land has at least not increased means that the sum total effect of other forces, of which technological change is certainly one of major significance, has been to decrease land's relative importance by an amount great enough to offset the effect of an increasing population."[12]

However, Garfield County followed the theoretical expectation in showing a definite increase in relative as well as absolute shares imputed to land.

The declining importance of the labor input in agriculture is a significant and general trend. There will be still more opportunities to develop new and more efficient machinery.

There is a definite increasing importance of management as a result of technological changes and therewith more capital intensive firms. The function of management is to draw up prospective goals and formulate plans to meet changing conditions. Technological change as a dynamic factor in agriculture and capital intensity increase the importance of management. Areas of relatively high capital intensity such as Garfield County include higher risks; they are more vulnerable to certain natural hazards and to declines in the general price level.

---

[12]Heady, Loc. cit.

The increase in relative share of income imputed to capital may be of two different types. Labor saving inventions which return a larger share imputed to capital because of the (1) greater productivity and (2) a substitution of capital for labor as a result of the changed marginal product/marginal cost ratios and the use of a greater amount of capital because of its greater productivity. However, returns to capital have increased in Garfield County only little or not at all because the size of the firm increased rapidly and offset the capital investment on a per acre basis, but the invested capital tends to be used more efficiently.

VI. CONCLUSIONS

1. The land in Garfield County increased its marginal productivity in comparison to the United States average farms since 1924 by approximately one third. The United States average farms show, on the contrary, a declining importance of land as a production agent.
2. The verification of the data indicates a declining importance of labor in agriculture as a consequence of technological change. This decline in Garfield County occurs at a relatively higher rate than for the average farms of the United States.
3. The slight increase in returns to capital and management in Garfield County is attributable to increased managerial activities rather than to new capital investments. The United States average farms, however, show a large increase of capital investments.
4. The average Garfield farms do not appear to have reached the optimum farm size at which the production agents such as implements and machinery may be used at their highest efficiency. A further increase in farm size seems justifiable.
5. The evidence indicates that the substitution of modern machinery for labor will probably continue. The problem therefore is, to remove inefficient and idle labor forces from the agriculture of the area.
6. An unrestricted inflow of capital into agriculture, connected with large risk insurances would tend to offset the hazards

that come with low prices. An increase in managerial ability through education would also be an offsetting factor.

BIBLIOGRAPHY

Bennett, M. K. Farm cost studies in the United States; their development, applications, and limitations. Stanford University, California, Food Research Institute, 1928.

Black, John D., Clawson, M., Sayre, Ch. R., Wilcox, W. W. Farm Management. New York: The Macmillan Company, 1947.

Black, John D. Introduction to Production Economics. New York: Henry Holt and Company, 1926.

Brewster, John M. "Farm Technological Advance and Population Growth." Journal of Farm Economics, XXII (August, 1945) 509.

Fitzpatrick, E. G., Boatright, W. C., and Rose, L. E. Soil Survey, Garfield County, Oklahoma. United States Department of Agriculture Bureau of Chemistry and Soils, Washington, D.C., 1939.

Forster, G. W. Farm Organization and Management. New York: Prentice-Hall, Inc., 1946.

Heady, Earl O. "Changes in income distribution in agriculture with special reference to technological progress." Journal of Farm Economics, XXVI (August, 1944), 435.

Honcamp, F. Handbuch der Pflanzenernahrung und Dungerlehre. Berlin: herausgegeben von F. Honcamp, 1931.

Leonhard, A. The cost of producing wheat in Garfield County in 1931. Unpublished Thesis, Dept. of Agri. Econ. Okla. A. & M. College, 1933.

Peterson, George M. Diminishing Returns and Planned Economy. New York: The Ronald Press Company, 1937.

Schultz, Theodore W. Agriculture in an Unstable Economy. New York and London: McGraw-Hill Book Company, Inc., 1945.

Schultz, Theodore W. "Changes in Economic Structure Affecting American Agriculture." Journal of Farm Economics, XXVIII (February, 1946), 15.

Spillman, W. S. and Lang, E. Law of Diminishing Returns. New York: World Book Company, 1924.

United States Department of Agriculture Bureau of Agricultural Economics. 1946 Agricultural Outlook Charts, Washington D.C.: 1945.

United States Department of Agriculture Weather Bureau. Climatological Data: Oklahoma Section 1929 to 1946.

United States Department of Commerce, Bureau of the Census; Census of Agriculture, 1930, 1935, 1940, 1945, Washington, D.C.

United States Department of Commerce, Bureau of the Census; Population Volume I, 1940, Washington, D.C.

Wilcox, Walter W. The Farmer in the Second World War. Ames: The Iowa State College Press, 1947.

Typist: Janet Croft