

THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

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of  
Committee on Thesis

The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by George Augustus Pond for the degree of Master of Science. They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science.

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May 27 1921

THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report

of

Committee on Examination

This is to certify that we the undersigned, as a committee of the Graduate School, have given George Augustus Pond final oral examination for the degree of Master of Science . We recommend that the degree of Master of Science be conferred upon the candidate.

Minneapolis, Minnesota

May 27 1921

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VARIATIONS IN THE COST OF CROP PRODUCTION  
WITH SPECIAL REFERENCE TO WHEAT COSTS.

A THESIS

Presented to the Faculty of the Graduate  
School of the University of Minnesota in  
Partial Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

George A. Pond.

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VARIATIONS IN THE COST OF CROP PRODUCTION  
WITH SPECIAL REFERENCE TO WHEAT COSTS.

INTRODUCTION.

History of Cost Studies.

The study of farm production costs is of comparatively recent development. It is only within the last few years that they have attracted general attention or that their real value has been understood and appreciated. The first organized systematic crop cost studies in the United States were initiated by the Minnesota Experiment Station in 1902 (11). This work was conducted in co-operation with the Bureau of Statistics of the United States Department of Agriculture. These cost studies have been continued at Minnesota ever since, either in co-operation with the United States Department of Agriculture or independently. Dr. T.N. Carver of Harvard University says of them, "the farm management studies of the University of Minnesota constitute the most thoroughly scientific and well grounded studies in agricultural economics which have been produced in America." (4). Beginning about 1910 crop cost studies were begun by several other state experiment stations either independently or in co-operation with the Office of Farm Management, U.S.D.A. The present widespread interest in farm cost accounting, however, dates from about 1916.

Application of Cost Data.

Milk Price Investigations. Probably the first application of farm

cost data to attract wide attention was the use of such data in the fight by the various milk producers associations to get a price for their product commensurate with the cost of production. The determined efforts of these associations coupled with the important part that milk plays in the human diet served to center widespread interest in this use of cost data. The entrance of the United States into the World War led to more general interest in questions relating to food supply and food prices. Mr. Herbert C. Hoover, the Federal Food Administrator, and numerous state food administrators appointed commissions to study the question of milk prices. (22). In appointing the committee for the Chicago district the food administrator stated as its purpose, "to name a price at which whole milk may be sold by producers in said district (Chicago district) which price shall cover the cost of production and a reasonable profit." (10). In practically every case cost of production was seriously considered as a basis for price fixing and, in many cases, adopted. In New York the "Warren formula" (22) for the production cost basis for milk price was recommended. In Chicago the Pearson formula (22) was used. Whatever the final decision of these commissions as to a price basis, their deliberations served to stress greatly in the minds of the farmer the importance of accurate cost data.

Government Price Fixing Activities. Another factor of great importance in arousing interest in production costs was the price fixing activities of the governmental agencies engaged in this work,- the Food Administration, the Fuel Administration, and the Price Fixing Committee of the War Industries Board. Prof. F.W. Taussig, a member of the latter committee said, "the basis upon



which the findings and agreements of the Price Fixings Committee rested was, in the main, the familiar and plausible one of cost of production." (37). The Fuel Administration also used production costs as a basis for price fixing. These war price-fixing activities of the government have undoubtedly been a most potent factor in awakening the very general interest now existing in cost data.

#### Purpose and Value of Farm Cost Data.

This rapidly awakening public interest in cost studies suggests a careful analysis of their real purpose, value, and usefulness as far as the farmer is concerned. Farm cost data is valuable to the farmer in planning his farm organization. The farm business, especially as it is found under the type of general or mixed farming that predominates in Minnesota, is a complex structure. It is composed of a number of enterprises whose joint contributions constitute the farmer's income. Even though the farmer may keep a set of books which tells him accurately what this income is, it does not in itself furnish a basis for reorganizing the farm to increase that income. It is only by a detailed study of the production costs for each enterprise that the contribution of each can be determined and comparisons made. Low profit enterprises can be detected and replaced by those offering a larger return over production cost. Not only must the net profit per acre be considered but also the facility with which the enterprises selected can be combined so as to make the most advantageous use of the farmer's labor and equipment. Dr. H.C. Taylor formulates the rule, "Everything considered, choose from each group of competing crops the one which will add most to the farmer's total

net profit and combine as many non-competing crops as will add enough to the total profits of the farm to make it worth his time to produce this crop rather than use the time for self-improvement or the enjoyment of life." (39). Cost data furnishes the basis for the selection within the competing groups.

Cost studies further enable the farmer to increase his efficiency as a producer. All farmers do not produce at the same cost as will be shown in considerable detail later. By studying the methods of those farmers who are producing at a low cost the farmer producing at a high cost may find a basis for reducing his own costs. He may also detect factors that make certain costs for a given crop under his conditions much higher than the same costs on the same crop grown by other producers more favorably situated. He can thus select those crops that can be grown most advantageously by him under his circumstances.

Another distinct value of cost of production studies is the determination of unit factors of cost. Unit quantities of the factors that compose the cost of a given unit of production can be determined quite accurately. By evaluating these at current prices an estimate of the cost of producing this unit can be readily made at any time. Opportunity costs can thus be estimated in advance and a comparison of profits from enterprises made. The unit factors also provide basic data for farm organization. They enable the farmer to determine in advance the capital, labor, and equipment requirements of any given enterprise. They enable him to ascertain in advance the provision necessary for a given amount of production or the duty possibilities of a certain amount of the factors of production.

Cost data furnishes a basis for price fixing and price

determinations. It is not the purpose of the writer, however, to advocate their general use for this purpose. It must be admitted that in the popular mind and especially in the mind of the farmer this is all too frequently considered the main purpose of cost studies. "Cost plus ten per cent" is the popular slogan of a large number of farmers in their somewhat misguided efforts to insure the profitability of their operations in defiance of economic law. To them it is the panacea for all the ills their business is heir to. Undoubtedly the price fixing activities of the government during the war was the source and origin of most of this sentiment. It must be admitted that in a great public crisis such as war, price fixing and price control may be necessary. Production costs, if not actually the basis, are at least an important factor in such price fixing operations. Price regulation may become a public necessity in large cities in insuring the supply at a reasonable price of some highly necessary food product as milk. Production costs always offer a possible basis for such price control.

#### Variations in Production Costs.

In all cost studies that have been made, the most significant and striking fact that has been brought out is that which forms the subject of this thesis - the variations in the cost of producing any given product. This is especially true of agricultural production. The Federal Milk Commission in its effort to fix the price of milk for the Chicago district on the basis of cost of production found in this variation an almost insurmountable barrier. Practically as many separate and distinct costs were presented as there were different individuals and agencies presenting the data. (10). Other milk commissions found similar

situations. The "Warren formula", (22), the "Pearson formula", (22), and others reflect this variation. The United States Department of Agriculture has found a similar situation in their investigation in the cost of cotton production (24), beef production (49), and wheat production (47). Although these variations have been found in all cost studies, it has been a common practice in the past to obscure or conceal them by presenting the data as general averages for a group of farms. However, the present tendency is to show the range of costs as well as the average cost. This new method of presenting cost data calls attention very forcefully to these variations and makes a discussion of them very timely.

Real Variations. The variations in production cost as shown by the results of any given study are caused by either of two variable factors. The first is the human factor or man's managerial ability and the second is the physical factor or nature's response to man's efforts. These two variables cause differences in costs between different farms in a given locality within a given year, differences in cost on the same farm from year to year, and differences between counties or sections of a state or between different states.

Apparent Variations. In addition to the real variations in production cost due to variations in the natural and human factors involved, there are other variations in published cost data that must not be overlooked in such a study as this. For want of a better term they will be designated as "apparent variations". They are due to variations in methods of calculation, differences of opinion as to what items should be considered as legitimate items of cost, differences in the apportionment of joint costs, and differences as to the purpose for which the data are to be used.



As will be more fully discussed later, opportunity costs may differ quite widely from true costs. Joint costs may be particularly disturbing to uniformity in results. (38). Our Minnesota farms produce a wide variety of crops, livestock, and livestock products. The same labor and equipment are used jointly in their production. The cultivation of the corn crop cleans the land and benefits the crops that follow. Small grains serve as a nurse crop to clover seeding. Manure benefits not only the crop to which it is applied but succeeding ones as well. The same is true of summer fallow. There is much time spent on every farm in general upkeep that is not directly chargeable to any crop or enterprise but rather is a joint cost to all. All these joint costs must be pro-rated and allocated according to the judgment of the accountant. It is true that they compose a minor part of the total cost and yet variations in them affect the total cost materially. It is, therefore, highly essential in interpreting any cost data, to know the methods used in handling the various items of cost in order to eliminate these so-called "apparent variations" and reduce all data to a comparable basis.

#### SOURCES OF MATERIAL.

##### The Wheat Crop.

In order to illustrate the variations in crop production costs and their importance and significance, the writer has chosen data on the wheat crop. More interest has been shown in the study of the cost of wheat production than in the cost of any other farm crop and more data has been published on the subject. This is to be expected in view of its economic importance. It is



the most widely grown of all the cereals and the most important food stuff of the human race. (9),(15),(42). It is also the most highly standardized of all farm crops as to cultural methods, markets and market grades, and prices. The fact that wheat is so widely grown and so highly standardized in the markets of the world makes it a particularly desirable crop to study in this connection, especially since the relation between cost of production and selling price holds such a prominent place in the mind of the producer at the present time.

#### Minnesota Wheat Cost Investigations. (45).

The detailed data used in this study to illustrate variations in wheat production costs have been computed and compiled from unpublished records in the possession of the Division of Agronomy and Farm Management of the Minnesota Experiment Station. These records were secured on six farms in three different counties of the state in co-operation with the Office of Farm Management of the United States Department of Agriculture during the years 1913 to 1917 inclusive. They were collected by the detailed cost account method which will be discussed later. The accompanying map, Figure 1, shows the location of these farms. Farm No. 1 is located in the Red River Valley where wheat growing is the major farm enterprise and the principal source of farm income. Farms 2 and 3 are also in a locality where wheat is the important cash crop and small grain farming predominates, but more stock is found on these farms. Farms 4,5, and 6 are located in a general farming locality where corn competes strongly with the small grains for the crop land, where feed crops are of considerable importance, and where considerable livestock is kept.

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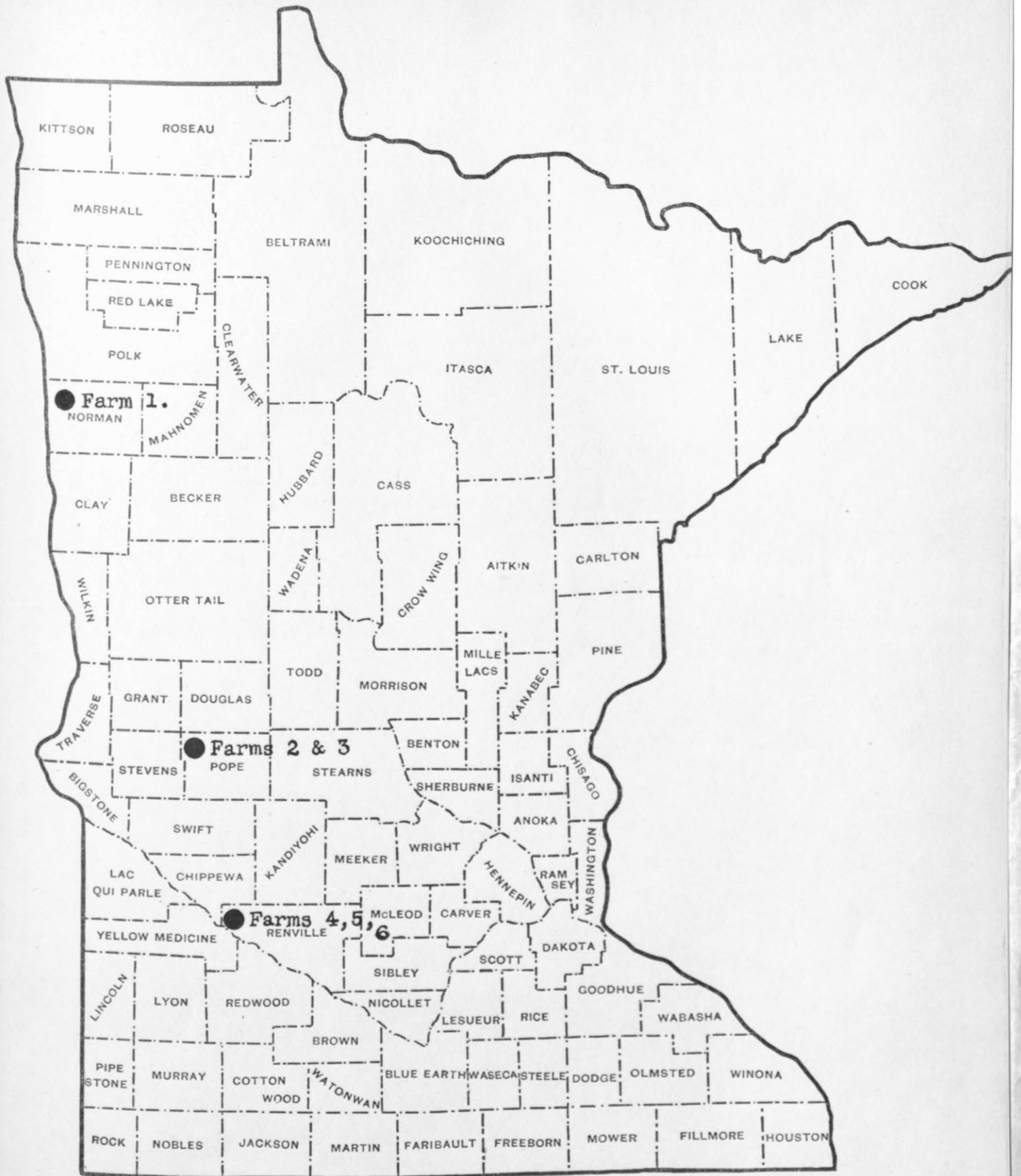


Fig. 1. Location of Farms Studied in Minnesota Wheat Cost Investigations. (45).

Table I.

Acreage of Wheat on Six Minnesota Farms, 1913-1917.

(Cost Account Date). (45)

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Total Acreage	Av'g. Acres per Farm.
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
1913	39.68	71.64		33.65	68.54		213.51	53.38
1914	94.56	91.46	26.68	49.63	52.53	47.20	362.06	60.64
1915		85.03	22.18	20.34	48.98	22.55	199.08	39.82
1916		71.52		9.16	21.83	21.34	123.85	30.96
1917		44.17	22.18	13.41	16.53	20.23	116.52	23.30
Av. Per Year	67.12	72.76	23.68	25.24	41.68	27.83	1015.02	42.30
% of Total Crop A. on Farm	38.5%	23%	15%	16.5%	20%	9.5%		20.5%

Table I shows the acreage of wheat on each farm each year. The data covers a little over a thousand acres of wheat which occupies on the average about one fifth of the total crop acreage of the farm. It is to be noted that figures are available on only three of the farms for the full five years. This is unfortunate in that it robs the averages of some of their significance and vitiates a number of conclusions that might otherwise be drawn.

Table II.

Acre Yield of Wheat on Six Minnesota Farms, 1913-1917. (45)

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Av.All Farms	State Av'g.
	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.
1913	+24.30	-17.25		-17.70	-13.86		18.28	16.2
1914	+16.26	- 8.95	- 9.30	-10.50	-10.38	+15.76	11.86	10.6
1915		-12.94	+18.30	-14.80	+20.91	-13.75	16.14	17.0
1916		- 5.72		+10.81	- 7.10	+13.35	9.25	7.6
1917		-10.94	- 9.92	+21.70	+22.69	+29.96	19.04	17.5
Av'g.	+20.28	-11.16	-12.51	-15.10	-14.99	+18.21	15.39	13.7

Table II shows the average yield per acre on these farms. A considerable variation is to be noted between the different farms, and on the same farm from year to year. There is little uniformity as to yields except that on farm 2 the yields are consistently low. It is to be noted that the average yield of wheat on these farms is slightly above the state average.

#### Published Data on Wheat Costs.

The detailed data computed from the unpublished Minnesota records have been supplemented by additional data presented in various publications and reports dealing with the subject of wheat production costs. These publications cover the results of studies in ten of the leading wheat producing states. These published data have been summarized and combined to illustrate facts and substantiate conclusions concerning variations in wheat production costs that are not evident from <sup>the</sup> limited data presented in the Minnesota records.



## METHODS OF COST STUDY.

There are several separate and distinct methods used in farm cost studies. The method used in such studies may have bearing upon the costs arrived at or upon the variations in costs between the results of different investigations or even of the same investigation. The statistical data to be presented later have all been collected by one of these three methods, the method being always indicated. An explanation of these methods is necessary for an intelligent evaluation of these data and an interpretation of the variations.

### Cost Accounting.

The first method used in cost studies was the detailed cost account method. (11) By this method complete, accurate, detailed information covering every phase of the farm business or at least of the production of the article studies is secured. There are two subdivisions of this method - the route method, and the correspondence and visitation method. In case of the first, a number of farms are selected in a given locality and a statistical agent or route man visits them at regular and frequent intervals. With the farmers' help he keeps complete cash, feed, labor, and miscellaneous records of the farm business. The correspondence method differs in that the farmers send their data directly to the compiling office and supervision by visitation is much less frequent or extensive. The unpublished Minnesota data already referred to were collected by this method. In either case these data are sent to a compiling office where all items of cost are allocated and apportioned and the cost of producing any given product computed.



These detailed cost studies not only give data on production costs but furnish valuable information on all phases of the farm business. This is the slowest and most expensive method of studying production costs but the accuracy and dependability of the results obtained fully justify the expense involved, especially in ascertaining detailed information on unit factors of cost.

#### Cost Survey.

The second method of cost study is the survey method. (47). The farmer is visited at the close of any given crop year by an investigator who questions him as to the various items that make up the cost of producing the particular crop under consideration. These questions the farmer answers from his memory or from such records as he may have kept. The items of cash cost and yield can usually be given with remarkable accuracy by the average farmer. The item of labor, however, can only be roughly determined by this method since the farmer's time is divided up between such a variety of enterprises that he cannot allocate accurately that expended on any particular crop. It is also difficult under this method to get equipment costs, building costs, labor rates, or a distribution of joint costs. However, the cost per farm studied is much lower than by the detailed cost account method and results can be obtained more quickly. Survey data may be supplemented by cost account data to give accuracy of detail as is being done by the United States Department of Agriculture in their study of beef productions costs in the corn belt. (46). The survey is chiefly useful in securing general estimates of cost rather than accurate detailed cost data.

### Questionnaire.

The third method of securing information on production costs is the questionnaire method. (23) A set of questions covering the cost of producing the product in question is mailed out to the producers. They are filled out by them to the best of their ability and mailed back to the inquirer. Obviously the results are not so accurate or comparable as those secured by the other two methods. No matter how simple a question may be or how carefully worded, there are always possibilities of its being misinterpreted. Consequently a hundred or a thousand answers sent in by as many persons will represent a wide variation in interpretation and therefore in the data secured. Even were all the producers to interpret all questions alike their estimate of costs and bases of valuation would vary so widely as to present a much wider range than the facts would warrant. The chief advantage of the questionnaire method is that it is the cheapest and most rapid method of obtaining cost estimates.

### Comparison of Methods.

In comparing these three methods one must conclude that cost accounts give the most valuable basis for studying the variations in cost between the individual farms. Each record from each individual farm is accurate in itself. This is especially true as regards factors of cost. By collecting these cost account data at frequent intervals and checking them closely the percentage of error is minimized. Methods used by different accountants in computing costs may vary somewhat but the unit factors themselves are fixed quantities and hence uniformly accurate. The accuracy of data

collected by the survey method is, in a considerable measure, dependent on the skill of the investigator in asking his questions in such a manner as to stimulate the farmer's memory and overcome his prejudices. Survey records carefully taken are useful in studying a range of costs but their greatest accuracy is attained in the matter of average costs. A much larger number of farms can be studied at a given cost by the survey method than by cost accounts and the law of averages serves to eliminate the errors in the individual records when the results are shown as an average figure for the whole study. (33) This is true, however, only in the absence of bias. This fact is well illustrated by Table III.

Table III.  
 Comparison of Survey Data with Statistical Data  
 On Acreage and Yield of Sugar Beets  
 In Minnesota - 1915. (27)

Locality.	Number Farms	Total Acreage	Av'g. Normal Acreage.		Av'g. Normal Yield	
			Survey	Factory Record	Survey	Factory Record
			Acres	Acres	Tons	Tons
Chaska	48	271.0	5.6	5.6	10.97	9.60
Cologne	5	16.2	4.5	3.2	14.10	12.87
Dassel	11	169.5	15.7	15.4	11.09	9.86
Dodge Center	17	114.2	6.4	6.7	10.86	8.80
Glencoe	17	157.4	8.4	9.2	9.22	10.52
Green Isle	3	80.0	26.6	26.6	7.25	6.70
Lesueur Center	6	46.4	6.8	7.7	9.16	9.99
Mankato	16	125.0	7.3	7.8	10.48	9.22
Montgomery	17	59.5	4.0	3.5	13.25	13.14
New Prague	12	111.0	8.5	9.2	13.05	11.63
Renville	9	179.9	21.0	20.0	10.26	9.40
Average per Acre			8.2	8.3	10.69	9.82

A survey was made of one hundred sixty one farms in eleven sugar beet producing areas in the state. (27). Later the data obtained was checked with the actual measured acreage recorded by the sugar company and the actual weighed tonnage yield with the result shown in this table. In case of acreage we note that whereas there is some variation between these two sets of data for different areas the over and under estimates just about balance each other and the average of the survey figures is practically identical with the actual measured acreage. In case of yield the survey estimates were higher than the actual weights in nine localities and below in only two and the average of the survey estimates for all the areas was nine percent above the actual recorded figure. The farmer estimates his acreage very carefully and accurately but yield is a matter of personal pride with him and he is a little inclined to overestimate somewhat in his desire to make a good showing. These data bring out quite clearly how in the absence of bias survey data may, through the workings of the law of averages, present accurate average figures even though the range of individual items composing them may be somewhat inaccurate. They further show the disturbing effect of bias on the accuracy of the average as well as the individual estimates.

The questionnaire method is obviously the least accurate of all and useable only in terms of averages. It is impossible to stress too strongly the importance of the influence of methods of securing data on the variations in published factors of cost and the importance of knowing the source of the data in order to evaluate conclusions based upon such data.



## FACTORS OF COST & METHODS FOR THEIR COMPUTATION.

The next important factor to be considered in studying cost variations is the method used in computing the factors that compose these costs. Just as methods of collecting data vary, just so are there various ways of computing different items of cost. Commercial cost accounting is an old and well established science as compared with farm cost accounting and yet there is still variation in the methods of commercial accountants in computing various costs. (6), (14), (21), (36). It is not strange, therefore, that farm accounting is not altogether standardized as to methods as yet.

### Uniformity in Cost Studies.

The American Farm Economic Association has been the pioneer in standardizing farm economics investigations and has done some work toward standardizing terms and methods. The most constructive contribution to the establishment of uniformity in cost studies is the report of the committee appointed by the Secretary of Agriculture to make recommendations as to prospective work to be done by the Office of Farm Management of his department (43). This committee, composed of the leading authorities in the United States on the subject of farm management and farm economics met in Washington, February 20 to 26, 1919. This report published as Circular 132, Office of the Secretary, lays down simple definite plans for uniformity in cost studies. In November 1920, a conference of all the investigators engaged in cost of production studies in the United States Department of Agriculture or in co-operation with the department was called in Chicago to clarify some of the points in the first committee's report and consider further standardization



of cost accounting terms and methods. The report of this conference is another valuable contribution to uniformity as to cost studies with a view to placing all investigations in different states on the same basis in order that the results may be directly comparable.

(44). All variations in methods must be eliminated as far as possible before variations in results can be intelligently studied and constructively interpreted.

#### True vs. Opportunity Costs.

There must be recognized in this connection the influence of the purpose for which the data are to be used on the methods employed and the items of cost to be considered. There are two general bases for cost study - true or operating costs and opportunity or alternate costs. True cost tells exactly what the production of a given unit costs at a given time and enables the producer to calculate his actual return over cost. It is valuable to study true cost in connection with price and in determining the actual financial status of the producer. This, however, is not primarily what the producer is interested in. In general he knows fairly well what his financial status is at any given time. The thing that he does want is to compare his several enterprises and to determine how best to employ his time and capital; and further, to determine whether he is getting as much return from it in the field of agricultural production as he could in some other industry. For that reason opportunity costs have prevailed in farm cost studies and the data presented in this thesis are all computed on that basis.

#### Items of Cost.

Labor Cost. The costs of crop production may be roughly divided into three classes - labor cost, land charge, and other costs. (2)

The first of these to be considered is labor. This includes both man and horse labor. As has already been indicated, only detailed labor records such as are kept up daily can furnish an accurate basis for studying variations in hours of labor. Survey or questionnaire data can only be used in rough or general comparisons or in averages.

There are various ways of arriving at the rate at which to charge man labor but in general they are based on the wages for hired men prevailing in the locality. All costs including wages and board are added up and divided by the total hours worked to get the rate per hour. All labor is then charged at this rate whether actually paid for, or gratuitously performed by members of the family or by the farmer himself without receiving any direct wage or compensation, except that when a crop requires an unusual amount of labor at a season of the year when additional labor can only be secured by paying a higher than average wage, this extra labor is kept separate and charged at the higher rate. High priced skilled labor such as is required on some crops may also be charged separately at a higher rate. Most investigators charge the high seasonal rate only when it is actually paid whereas others charge all labor at the higher rate during the period that it prevails even though it may be a rate paid only to extra day men and much higher than the rate for regular month or year employees. The former method is indorsed by the United States Department of Agriculture and is in most general use. These two methods of arriving at labor rates may cause some artificial variation in final cost figures.

Another factor to be considered in connection with labor costs and labor rates is the item of supervision or "wages of

management." A few farm cost accountants include this in the regular labor charge. (41). It is, however, usually handled as a separate charge and not confused with actual costs. Obviously it is not an item of operating or true cost at all and should be paid out of the profits accruing as the result of managerial ability used. However, in the presentation of opportunity costs it is quite frequently shown. The horse labor rate is computed by dividing the total horse costs by the total hours worked by the horses during the year, no differentiation being made for rush or slack seasons. The only variation in methods of computing horse costs is that sometimes the total horse cost is based on the entire horse enterprise including colts while in others it is based on work horses only. The United States Department of Agriculture uses the latter method.

Land Charge. The second important production cost to be considered is the charge for the use of land. Practically all published data on crop costs contains such an item. Commercial accountants are, however, divided on the subject of including a land charge, that is, interest or rental value as a production cost. They hold that it is not a cost and any returns from land should form part of the profits. Such accountants as J. Porter Joplin, (21), W.B. Richards, (31), J.E. Sterritt (34), and Stanley E. Howard (14), hold to this view. They are opposed by Prof. F.W. Taussig (36), William Morse Cole (6), Edw. L. Suffern (35), and W.B. Castenholz (5). Prof. Taussig says "Only so much of a man's income should be regarded as profits as is in excess of interest on the capital he manages." Prof. Cole argues further, "We have seen that for analytical purposes, in studying operations, practical necessity requires us at least to consider interest in virtually all calculations where

investment is involved, and we have seen that in financial statements practical convenience is served by the treatment of interest as a charge or cost rather than as a residue or profit." Since the farm accountant is primarily interested in the opportunity cost he follows the latter group of accountants in including the land charge as a production cost.

There are three general methods for computing the land charge. The first is that of charging interest at the current mortgage rate on the original cost of the land plus the value of the improvements that have been added to it, plus taxes, upkeep, etc. The second is to charge interest on the present sale value of the land plus taxes, upkeep, etc. (2). The third is to charge either the going cash rent or the value of such share as is given for the use of the land (2). Of these three the second is recommended by both reports on standard methods in cost study already referred to. The first is rejected since it does not represent an alternative use of the actual existing value of the capital involved. The farmer can always sell at the going market valuation and by investing the proceeds in a farm mortgage get the going rate of interest on the present valuation. Cash rent also represents an alternative use of the farmer's capital but in many localities cash rents are so uncommon as to furnish an insufficient basis for a land charge and share rent varies so widely with yield and price that it does not furnish a stable basis for a land charge. Cash rent is usually lower than share rent and also lower than the land charge based on an interest charge on the sale value of the land. This fact must be kept in mind in studying variations in land charges and the basis for the charge must be known before its significance can be evaluated.



Other Costs. There are a number of miscellaneous costs of crop production, each one comparatively small in itself, but the sum aggregating a considerable item, usually classed as "other costs." These costs are as follows: - seed, twine, threshing, machinery, fertilizer, insurance and risk, and overhead. The items of seed and twine are mere matters of record of amounts used valued at current prices. The cost of threshing includes the cost of any fuel, oil, or other material used in addition to the regular bushel rate. This item of cash cost varies widely on account of varying practices in regard to the amount of labor used and the method of paying for it. Where the thresherman furnishes only the machine crew the cost per bushel is low since the farmer must hire all the additional help needed and it is included in the labor cost. On the other hand it is the custom in some localities for the thresherman to furnish the entire crew for operating the machine including teams in case of shock threshing and even boarding the crew and furnishing their quarters. This results in a very high bushel cost. Between these two extremes lies a considerable variety of practices that cause a corresponding variation in threshing cost. To be sure, this variation does not affect the total cost since it is only a question as to whether this labor is included in the regular labor charge or whether it is charged as a threshing cost. It does, however, affect factor variations and must be kept in mind from that standpoint.

The machinery charge includes taxes, depreciation, repairs, and lubricants for the machinery used on the crop. This charge is pro-rated to the crops on the basis of hours used.

Commercial fertilizer is charged at its market value or cost. In case of a fertilizer completely exhausted in one year, the



entire cost is charged against the crop to which it is applied. If the fertilizer has a residual value its cost is pro-rated to succeeding crops according to its estimated utilization or exhaustion. Farm manures are usually charged at an estimated value per ton based on the increased crop production resulting from its use. Since manure has a residual value this charge is also pro-rated through the estimated life of its utilization. Fertilizer costs are one of the highly variable items of crop cost since they vary from nothing on some farms and with some crops to considerable items on others where considerable manure and especially where large amounts of expensive commercial fertilizer are used.

Insurance or crop risk is often included as a production or crop cost. In case of simple crop insurance this is handled as a direct charge against the crop insured. In some localities where climatic conditions fluctuate widely or the weather hazard is an important item as in the semi-arid regions of the west, allowance is made for the fact that a crop cannot be expected each year. The normal or average loss is computed and charged annually to the acreage harvested as a crop risk charge. This item varies widely between different localities representing varying soil and climatic conditions.

In addition to the charges already mentioned, there is always a certain amount of labor expended and other costs incurred on every farm that is not productive in itself and which is not directly chargeable to any one enterprise. This is known as "overhead" or "on-costs" and is distributed to the productive enterprises, usually on the basis of all other costs. This item varies widely with the farmer's ability to employ his time and resources productively.

### Crop Credits.

In connection with the costs of production must be considered any credits other than the main product that serve to offset part of the costs. In case of wheat the grain is the main product but often the by-product has a market value that is credited by the cost accountant. In winter wheat areas it is often a standard practice to pasture the growing crop and in many cases this practice is so general as to establish a regular pasture rate for the area. It is obvious that a straw or pasture credit may serve to lessen materially production costs where these by-products are marketable.

### Cost Units.

In expressing production costs there are two general units or bases that may be used; - the acre or the bushel. Since the acre furnishes the most stable basis it is most commonly used. The acre cost does not vary from year to year or from farm to farm with differences in yield as does the bushel, cost and it furnishes a standard basis for comparing costs between crops whose yields per acre and weights per bushel may vary. The acre furnishes a stable basis for studying variations in factors of cost. Bushel costs are useful particularly in comparing and studying costs in relation to price. They are valuable in connection with acre costs to indicate the significance of crop yields and their effect on costs and returns.

### METHODS OF PRESENTING COST DATA.

The wide variations in production costs that have already been mentioned leads to a study of methods of presenting cost data so as to bring out their significance. No interpretation of crop

costs is complete that does not reckon with this omnipresent cost range. It is necessary to have some measure or coefficient of expression in presenting a variable item. There are several methods or measures used by statisticians in presenting a large group of varying items so as to give a definite picture or summary of the group. (22a).

#### Mode.

One of these is the mode or item of most frequent size. (22a) This, however, has never been used in presenting farm costs. It cannot be located by any simple arithmetic process, it is not readily understood by farmers and many others interested in crop cost publications and it may be so affected by a comparatively few items of uniform size in a large group of varying items as to be of little significance. Its principal advantage is that it is not affected by abnormal extremes in either direction but its disadvantages so outweigh this point that it is not used.

#### Median.

The median or middle item in a range of costs is another measure used by statisticians (22a). This has the same advantage as the mode - it is not disproportionately affected by abnormal extremes. It, however, shares with the mode the fact that it is not readily understood and not easily located arithmetically. It is principally used with data, the items of which are not susceptible of measurement in definite units. It may fall at a point where very few items actually occur. It is not used in presenting crop costs.

#### Average.

The third type or measure used in presenting a range of variations is the average, either simple or weighted (22a).

This is easily computed and generally understood. It is affected by every item and is not disproportionately influenced by any small group of items. Its chief disadvantage lies in the fact that it may fall at a point where no item actually occurs. The average has been the most commonly used measure in presenting crop costs in most cost publications.

#### The Frequency Table.

There has grown up recently a change in methods of presenting cost data as evidenced by the later crop cost publications. The importance of the variations in cost have been recognized to the extent that the average is now being supplanted by the range or frequency table. As a matter of fact there is no such thing as an average farm, an average farmer, or an average combination of soil and climatic conditions, and hence the average cost may be a purely hypothetical or computed cost, not existing in fact on any given farm. The frequency table shows the costs just as they occur. It shows the extremes as well as the grouping of costs. It shows the range of cost possibilities. In practically all crop cost publications at the present time variations in cost are recognized to the extent that averages are being supplemented by the frequency table.



Table IV.

Variations in The Net Cost Per Bushel of Winter Wheat in Nebraska - 1919 (47).

Net Cost per bushel	Kieth County			Saline County			Phelps County.		
	No. Farms	Cumul.% of Farm	Cumul.% of Prod.	No. Farms	Cumul.% of Farms	Cumul.% of Prod.	No. Farms	Cumul.% of Farms	Cumul.% of Prod.
\$1.00	1	4.4	11.3						
1.10									
1.20	1	8.8	13.4						
1.30	3	21.8	25.1						
1.40	2	30.5	34.5	1	2.9	3.0			
1.50	3	43.5	55.6						
1.60	2	52.2	58.6	1	5.8	6.4	1	3.3	4.3
1.70	3	65.2	64.9	1	8.7	8.3			
1.80	3	73.9	72.8	1	11.6	11.0	2	10.0	11.4
1.90	2	82.6	83.5	2	17.3	18.6	3	20.0	30.4
2.00	3	95.6	99.8	4	28.7	30.6	3	30.0	54.1
2.10				8	51.5	51.8	3	40.0	64.5
2.20				4	62.9	66.0			
2.30				2	68.6	71.5	1	43.3	68.0
2.40				3	77.2	82.2	4	56.7	76.4
2.50				1	80.0	85.2	4	70.1	84.8
2.60				3	88.6	94.5	1	73.4	86.7
2.70				1	91.4	95.9	1	76.7	89.1
2.80				1	94.2	96.7	3	86.7	93.1
2.90				1	97.1	98.6	1	90.0	94.4
3.00									
3.10	1	100.0	100.0						
3.20									
3.30									
3.40							1	93.3	97.0
3.50							1	96.6	98.4
3.60				1	100.0	100.0	1	100.0	100.0
Average Cost			\$1.57			\$2.17			\$2.20
Median			1.60			2.10			2.40
Mode			1.70			2.10			2.40

Table IV presents a comparison of mode, median, and average and illustrates their location on the frequency table and their use in connection with the range. In Keith County there is no distinct mode but the median and average are practically the same. In Saline County the mode is very distinct and the median lies within the modal group. In Phelps County the average happens to fall upon a point where no items occur. The median again falls within the modal group although the mode is not at all distinct. The range in each case not only tells at a glance the cost at which the majority is producing, but it shows the abnormal extremes in their true light and sets forth the whole cost situation graphically. The average, or the mode or median for that matter, is merely a condensing of the range into a single figure for ease and convenience in expression. Of necessity much of the significance of the individual variations must be sacrificed in this condensing process.

#### "Bulk-Line" Cost.

In addition to the different methods of presenting costs and the different cost measures and expressions just described, there is what is known as the "bulk-line" cost. (37). This term and the principal involved was used by the various boards invested with price fixing powers during the war period and has only come into use in connection with crop costs during the past three years. It is not the purpose of this thesis to discuss costs in their relation to price but since the term "bulk-line" cost is becoming so generally used in presenting cost data, no discussion of cost variations would be complete without reference to its significance. The "bulk-line" cost is really the "necessary" price, or price which would stimulate the required or desired amount of production. As

yet sufficient work has not been done on the subject of costs, price relations and trends, and consumptive demands to locate with any degree of accuracy the "bulk-line" cost for wheat or any given commodity. During the war a price covering the cost of eighty to ninety percent of the total production was allowed. The cost at this point was called the "bulk-line" cost. The method of locating this cost may be illustrated by reference to Table V.

Assuming that ninety percent of the cost should be covered, the "bulk-line" cost for the three states whose costs are shown in the first group would be a trifle under three dollars and eighty cents. Although only seventy seven percent of all the farms are producing at or below this cost it would be sufficient to insure re-turns for labor and capital on ninety percent of the production. The "bulk-line" cost for the Clay County farms would be almost exactly the same and only about the same percentage of farms would be covered. In Traverse County the cost would be just below three dollars and fifty cents per bushel and would cover the same percentage of farms as of production. It is to be noted that the "bulk-line" cost is considerably above the average cost and that the "bulk-line" cost for one set of data may be higher than for another set and yet the average cost be lower. This is shown by a comparison of the figures from the three states with those from Traverse County. The "bulk-line" cost is of interest primarily from the standpoint of price relations and price fixing and is not of any significance to the farmer in studying his own costs from a farm management standpoint. It is presented here merely to illustrate its use in connection with variations in cost.

Table V

Variations in Net Cost per bushel of Spring Wheat, 1919.  
(Survey Data) (47)

: Spink Co., S.D. Morton & :									
: Grand Forks Co., N.D., & :									
: Clay and Traverse County: :									
: Minnesota :									
Clay County, Minnesota :					Traverse County, Minnesota :				
Net Cost Per Bu.	No. of Farms	Cumulative % of Farms	Cumulative % of Production	No. of Farms	Cumulative % of Farms	Cumulative % of Production	No. of Farms	Cumulative % of Farms	Cumulative % of Production
1.10:	1	.5	.3	:	:	:	:	:	:
1.20:	:	:	:	:	:	:	:	:	:
1.30:	1	1.0	1.9	:	:	:	:	:	:
1.40:	:	:	:	:	:	:	:	:	:
1.50:	1	1.5	3.2	:	:	:	:	:	:
1.60:	3	3.0	6.4	:	:	:	:	:	:
1.70:	3	4.5	8.1	:	:	:	:	:	:
1.80:	4	6.5	14.9	:	:	:	:	:	:
1.90:	8	10.6	20.6	1	2.6	1.6	1	2.4	2.3
2.00:	8	14.7	24.5	:	:	:	1	4.8	3.3
2.10:	8	18.8	29.8	3	10.5	8.8	1	7.2	4.9
2.20:	10	23.9	34.9	1	13.1	10.6	2	12.0	10.3
2.30:	11	29.5	47.1	1	15.7	35.6	3	19.1	20.4
2.40:	10	34.6	51.5	1	18.3	37.3	5	31.0	30.9
2.50:	7	38.2	54.9	1	21.0	40.7	3	38.1	37.0
2.60:	13	44.8	64.3	3	28.9	57.8	3	45.2	46.4
2.70:	12	50.9	69.3	7	47.4	69.5	1	47.6	50.1
2.80:	8	55.0	72.3	1	50.0	71.9	5	59.5	63.1
2.90:	6	58.1	75.6	1	52.6	74.7	3	66.6	71.1
3.00:	7	61.7	77.7	:	:	:	2	71.4	74.6
3.10:	3	63.2	79.1	:	:	:	2	76.2	79.7
3.20:	3	64.7	80.1	:	:	:	3	83.3	85.9
3.30:	6	67.8	82.8	:	:	:	1	85.7	86.8
3.40:	5	70.3	85.1	2	57.9	76.6	:	:	:
3.50:	6	73.4	87.6	3	65.8	82.8	2	90.4	91.5
3.60:	2	74.4	88.5	:	:	:	1	92.8	94.0
3.70:	3	75.9	89.2	2	71.1	84.7	:	:	:
3.80:	4	77.9	90.9	3	79.0	91.5	:	:	:
3.90:	5	80.5	91.7	:	:	:	1	95.2	95.5
4.00:	:	:	:	:	:	:	:	:	:
4.10:	2	81.5	92.4	1	81.6	92.0	:	:	:
4.20:	4	83.5	93.3	1	84.2	92.4	1	97.6	99.2
4.30:	2	84.5	93.8	1	86.8	93.9	:	:	:
4.40:	3	86.0	94.7	3	94.7	97.7	:	:	:
4.50:	3	87.5	95.9	1	97.4	98.6	:	:	:
4.60:	3	89.0	96.4	:	:	:	:	:	:
4.70:	3	90.5	96.8	:	:	:	:	:	:
4.80:	:	:	:	:	:	:	:	:	:
4.90:	2	91.5	97.1	:	:	:	1	100.0	100.00
5.00:	2	92.5	97.5	1	100.0	100.00	:	:	:
Average Cost	:	\$2.65	:	:	:	\$2.82	:	:	\$2.80



Table VI  
Average Cost of Producing Wheat in Different Localities, 1902-1920.  
(Survey, Cost Account and Questionnaire Data)

Locality	ACRE COSTS																		
	1902:	1903:	1904:	1905:	1906:	1907:	1908:	1909:	1910:	1911:	1912:	1913:	1914:	1915:	1916:	1917:	1918:	1919:	1920:
Lyon Co., Minn. (25)(26)	:	:	:8.39:	:	:	:	:	:	:12.61:	:	:	:	:	:	:	:	:	:	:
Norman Co., Minn. (25)(26)(28)	:	:	:6.98:	:	:	:	:	:	:10.37:	:11.59:	:	:	:15.41:	:	:17.81:	:	:	:	:
Rice Co., Minn. (25)(26)	:	:	:9.86:	:	:	:	:	:	:13.04:	:	:	:	:	:	:	:	:	:	:
Wright Co., Minn. (28)	:	:	:	:	:	:	:	:	:	:	:	:	:17.85:	:	:	:	:	:	:
1920 Acre Farm, Minn. (25)	:	:	:6.06:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
N. Dak. (eastern) (29)(41)	:	:	:	:	:	:8.14:	:11.34:	:9.95:	:8.34:	:11.09:	:11.55:	:	:	:	:	:	:	:	:21.66:
N. Dak. (western) (29)(41)	:	:	:	:	:10.51:	:9.03:	:7.62:	:9.29:	:6.03:	:5.45:	:8.53:	:	:	:	:	:	:	:	:15.11:
Iowa (48)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:35.78:
Kansas (46)(23)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:27.76:	:26.74:	:
Nebraska (30)	:	:	:	:	:	:	:	:12.07:	:12.31:	:	:	:	:	:	:	:	:	:	:
Montana (8)	:	:	:	:	:	:	:	:	:	:	:	:	:17.08:	:	:	:	:	:	:
Missouri (18)(19)(20)	:	:	:	:	:	:	:	:	:	:11.5:	:	:	:12.81:	:12.55:	:12.77:	:17.06:	:	:	:27.83:
Minnesota, N.D., S.D., (47)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:22.40:
Kan., Nebr., Mo., (47)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:27.80:
BUSHEL COSTS																			
Lyon Co., Minn.	:	:	:.56:	:	:	:	:	:	:.57:	:	:	:	:	:	:	:	:	:	:
Norman County, Minn.	:	:	:.56:	:	:	:	:	:	:.62:	:.69:	:	:	:.90:	:	:1.03:	:	:	:	:
Rice County, Minn.	:	:	:.78:	:	:	:	:	:	:.82:	:	:	:	:	:	:	:	:	:	:
Wright County, Minn.	:	:	:	:	:	:	:	:	:	:	:	:	:1.00:	:	:	:	:	:	:
1920 Acre Farm, Minn.	:	:	:.52:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
North Dakota (eastern)	:	:	:	:	:	:.58:	:.55:	:.48:	:.64:	:.43:	:.42:	:	:	:	:	:	:	:	:2.11:
North Dakota (western)	:	:	:	:	:.55:	:.79:	:.37:	:.29:	:2.41:	:.78:	:.20:	:	:	:	:	:	:	:	:3.34:
Iowa	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:1.93:
Kansas	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:1.95:	:2.11:	:
Nebraska	:	:	:	:	:	:	:.53:	:	:.57:	:	:	:	:	:	:	:	:	:	:
Montana	:	:	:	:	:	:	:	:	:	:	:	:	:.54:	:	:	:	:	:	:
Missouri	:	:	:	:	:	:	:	:	:	:.78:	:	:	:.78:	:1.08:	:1.54:	:1.22:	:	:	:2.18:
Minn., N. Dak., S. Dak.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:2.65:
Kan., Nebr., Mo.	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:1.87:

## COMPUTED COSTS OF WHEAT PRODUCTION SHOWING VARIATIONS.

Table VI presents the variations in wheat production costs as shown by the published results of investigations in some of the principal wheat producing states of the union covering a period of nearly twenty years. Both acre and bushel costs are shown. It is to be noted that in general there is a gradual increase in the acre costs from year to year up to 1917. This is neither uniform or steady and represents only a general trend. However, the rapid rise in price levels in all lines subsequent to the entrance of the United States into the World War is sharply reflected in the rapid rise in production costs during 1917. The rise continues up to 1920 which year presents the highest acre cost in the history of wheat cost investigations. The bushel costs fluctuate more widely than do the acre costs due to the introduction of fluctuating yields as an added factor in causing variations. However, their general trend is in the same direction but the higher yields in 1920 in Iowa and Missouri serve to lower the bushel costs below the maximum attained in 1919 in other localities. It must be remembered that the chronological variations in cost are much more significant for the data from any single source than when used to compare the results of different investigations. This is due to the fact already referred to, - the difference in methods of study used and the difference in methods of calculating costs by different investigators. Only very general conclusions can be drawn from such a table as this.

Table VII.  
 Variations in Factors of Cost in Wheat Production and  
 in Acre and Bushel Costs on Six Minnesota Farms, 1913-1917.  
 (45)  
 (Cost Account Data)

Farm	Year	Labor Cost	Land Charge	Other Cost	Total Costs	Yield per Acre	Cost per bu.
No. 1	1913	\$4.14	\$3.92	\$3.20	\$11.26	Bu. 24.30	\$.46
	1914	2.23	4.41	3.34	9.98	16.26	.61
Av'g.		3.18	4.17	3.27	10.62	20.28	<u>.52</u>
No. 2	1913	4.31	2.66	4.15	11.12	17.25	.64
	1914	4.33	2.75	3.29	10.37	8.95	1.16
	1915	5.21	2.78	4.86	12.85	12.94	.99
	1916	5.80	2.87	6.18	14.85	5.72	2.60
	1917	6.57	2.91	4.97	14.45	10.94	1.32
Av'g.		5.25	2.79	4.69	12.73	11.16	<u>1.14</u>
No. 3	1914	2.32	3.32	2.44	8.08	9.30	.87
	1915	3.55	3.35	3.51	10.41	18.30	.57
	1917	4.58	3.70	4.86	13.14	9.92	1.32
Av'g.		3.48	3.46	3.60	10.54	12.51	<u>.84</u>
No. 4	1913	3.64	6.44	3.95	14.03	17.70	.79
	1914	3.89	6.86	4.44	15.19	10.50	1.45
	1915	4.64	6.31	11.67	22.62	14.80	1.53
	1916	4.63	6.40	7.28	18.31	10.81	1.69
	1917	4.81	6.53	8.42	19.76	21.70	.91
Av'g.		4.32	6.51	6.95	17.58	15.10	<u>1.16</u>
No. 5	1913	2.48	5.95	3.76	12.19	13.86	.88
	1914	3.20	5.86	3.81	12.87	10.38	1.24
	1915	3.46	6.07	6.83	16.36	20.91	.78
	1916	2.72	6.31	6.56	15.59	7.10	2.20
	1917	5.40	6.93	8.12	20.45	22.69	.90
Av'g.		3.45	6.22	5.82	15.49	14.99	<u>1.03</u>
No. 6	1914	4.53	5.93	3.86	14.32	15.76	.91
	1915	3.53	5.77	5.34	14.64	13.75	1.07
	1916	3.62	5.85	5.60	15.07	13.35	1.13
	1917	3.88	5.91	6.20	15.99	29.96	.53
Av'g.		3.89	5.87	5.24	15.00	18.21	<u>.82</u>

Variations by Farms. Table VII shows the variations in wheat costs for five years on the six Minnesota farms referred to in Tables I and II and whose location is shown on Figure I. Here there is no distinct tendency for acre costs to increase markedly until 1917. In that year, however, the sharp upturn of costs is very noticeable. There is no uniformity at all in the fluctuations in bushel costs. The data on these farms are strictly comparable in all respects since they were all collected and computed by the same investigator and the methods used on the different farms were uniform in principle and practice.

Table VIII.

Variation in the Cost of Producing Wheat on  
Six Minnesota Farms, - 1913-1917 (45)

(Cost Account Data)

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Av'g.All Farms
	A C R E C O S T S.						
1913	\$-11.26	\$-11.12		\$+14.03	\$+12.19		\$12.15
1914	- 9.98	-10.37	-8.08	+15.19	+12.87	+14.32	11.80
1915		-12.85	-10.41	+22.62	+16.36	-14.64	15.38
1916		-14.85		+18.31	-15.59	-15.07	15.96
1917		-14.45	-13.14	+19.76	+20.45	-15.99	16.76
Av'g. Cost	-10.62	-12.73	-10.54	+17.58	+15.49	+15.00	14.32
	B U S H E L C O S T S.						
1913	- .46	- .64		+ .79	+ .88		.69
1914	- .61	+ 1.16	- .87	+ 1.45	+ 1.24	- .91	1.04
1915		.99	- .57	+ 1.53	- .78	+ 1.07	.99
1916		+ 2.60		- 1.69	+ 2.20	- 1.13	1.91
1917		+ 1.32	+ 1.32	- .91	- .90	- .53	1.00
Average Cost	- .52	+ 1.14	- .84	+ 1.16	+ 1.03	- .82	.96



Table VIII shows the acre and bushel costs for the same group of farms shown in Table VII. There is an extreme range in acre costs from \$8.08 to \$22.62 on all farms and from \$14.03 to \$22.62 on the same farm. It is to be noted that these extremes were in succeeding years and not at a period of rapid rise in prices. It is also worthy of note that each farm is characteristically a high or low cost farm as compared with the average for the year. On some farms the acre costs are quite uniform from year to year whereas on others they vary widely. Bushel costs are much less uniform than are acre costs and are not directly proportioned to them. The extreme range of bushel cost on a single farm is from \$.64 to \$2.60 and within a year on all farms from \$1.13 to \$2.60. The extreme range for the five years is from \$.46 to \$2.60.

Table IX presents the range in production costs on both the acre and bushel basis on different farms within the county and between different counties. The maximum range of acre costs is found in Jewell County, \$15.74 to \$54.72, a variation of \$38.98, per acre. The extreme range among all the farms studied was from \$9.79, to \$54.72, or a variation of \$44.93, per acre. The widest range in bushel costs within the county is from \$2.81, to \$19.53. The extreme range in all counties is from \$.86 to \$19.53 or a Variation of \$18.67 in the cost per bushel.

Table IX.

Variations in the Cost of Producing Wheat  
 on Individual Farms in Kansas - 1918. (46).  
 (Survey Data)

County	No. of Farms	Cost per Acre		Yield per Acre			Cost per Bushel	
		Av'g. per Acre	Range per Acre	Av'g. bus.	Range bus.	Av'g.	Range.	
Harvey	60	\$26.50	\$18.89 to 38.82	18.0	10.88 to 24.0	\$1.47	\$.86 to 2.45	
Jewell	20	24.66	15.74 " 54.72	16.7	9.5 " 35.0	1.48	.88 " 3.04	
Sedgewick	40	30.26	21.90 " 49.98	19.4	7.37 " 30.0	1.56	1.14 " 3.01	
Sumner	20	30.30	23.16 " 37.78	17.8	9.0 " 25.0	1.70	1.22 " 3.53	
Cherokee	20	30.48	23.34 " 50.40	17.7	11.0 " 24.17	1.72	1.17 " 2.93	
Doniphan	20	37.32	25.42 " 51.82	19.7	8.0 " 28.19	1.89	1.21 " 3.18	
Pottawatomie	20	36.83	28.84 " 46.70	19.1	11.0 " 28.0	1.93	1.36 " 4.12	
Barton	20	23.62	19.68 " 33.86	10.8	4.0 " 19.0	2.19	1.50 " 6.25	
Thomas	20	13.93	9.79 " 32.45	6.0	1.0 " 10.0	2.31	1.02 " 10.65	
Ellis	20	24.06	16.42 " 38.79	10.2	5.0 " 17.0	2.35	1.45 " 4.16	
Clay	20	27.35	23.80 " 32.79	11.3	5.8 " 15.85	2.42	1.83 " 4.17	
Ford	20	18.58	13.98 " 26.99	3.4	1.0 " 6.0	5.48	2.81 " 19.53	

Table X.

Variations in Wheat Production Costs  
per Acre by Farms - 1919. (47).

(Survey Data)

Districts	No. of Records	Under \$20.00	\$20.00 to \$25.00	\$25.00 to \$30.00	\$30.00 to \$35.00	\$35.00 to \$40.00	\$40.00 and over
<u>Minnesota</u>							
Traverse Co.	42	4	21	14	2	0	1
Clay Co.	38	6	17	9	6	0	0
<u>So. Dak.</u>							
Spink Co.	39	5	20	12	2	0	0
<u>No. Dak.</u>							
Grand Forks Co.	39	10	18	9	2	0	0
Morton "	39	21	12	6	0	0	0
Total	197	46	88	50	12	0	1
% of Tot.	100	23	45	25	6	-	1

Table X presents the range in acre costs by farms in three spring wheat states. A range in cost from \$20.00 to \$35.00, is shown in four counties and a range up to over \$40.00, per acre in a fifth. In the first four counties the largest number of farms in a single cost group is found in the \$20.00 to \$25.00 per acre group. In Morton County, North Dakota, the majority of the farms produced wheat at a cost of less than \$20.00 per acre.

Table V which has already been discussed in connection with "bulk-line" costs shows the range in bushel costs between the farms in two of the counties shown in Table X as well as the range for all the five counties. It is to be noted that the minimum cost was the same in both Minnesota Counties and the maximum costs were only ten cents apart. There was a difference of only two cents in

the average cost per bushel. The range for these two counties is quite uniform. The extreme range in cost is from \$1.90 per bushel to \$5.00 per bushel. In both counties more than fifty percent of all the costs lie between \$2.00 and \$3.00 per bushel. For the five counties a lower average cost and a much wider range is noted. The extreme range for these counties was from \$1.10 per bushel to \$14.40 a bushel.

Table XI.

Yearly Variations in Wheat Production Costs  
on Bathgate Demonstration Farm, North Dakota. (29).  
(1907 - 1912)

Year	Acre Costs.				Yield per Acre	Cost per Bu.	Percent of Total.		
	Labor Cost	Land Charge	Other Cost	Total Costs			Labor Cost	Land Charge	Other Costs
					Bu.		%	%	%
1907	\$1.98	\$2.40	\$3.76	\$8.14	14.0	\$.58	24.3	29.5	46.2
1908	1.83	2.70	6.81	11.34	20.46	.55	16.1	23.8	60.1
1909	1.88	2.70	5.37	9.95	20.56	.48	18.9	27.2	53.9
1910	1.63	3.00	3.71	8.34	13.00	.64	19.6	36.0	44.4
1911	2.56	3.00	5.53	11.09	25.88	.43	23.1	27.1	49.8
1912	2.69	3.00	5.86	11.55	27.63	.42	23.3	26.0	50.7
					Average		21.%	28%	51%

Variations by Years. Table XI shows the variations by years in wheat production costs on the Bathgate demonstration farm in North Dakota for the years 1907 to 1912 inclusive. The extreme range of costs is from \$13.00 to \$27.63 per acre and from \$.42 to \$.64 per bushel. The tendency for acre costs to increase through a period of years as was discussed in connection with Table VI is also apparent here but again the fluctuations in bushel costs are not at all uniform.



Table XII.

Variations in the Cost of Producing Wheat  
in Missouri by Years. (20).

(Cost Account Data)

Year	Acre Costs.				Yield in Bus.	Cost per Bus.	Percent of Total.		
	Labor Cost	Land Charge	Other Costs	Total Cost			Labor Cost	Land Charge	Other Costs
					Bu.		%	%	%
1910- 11-12									
-13	\$3.90	\$4.02	\$3.59	\$11.51	14.7	\$.78	33.9	34.9	31.2
1914	4.88	4.43	3.50	12.81	16.4	.78	38.1	34.6	27.3
1915	4.90	4.25	3.40	12.55	11.6	1.08	39.1	33.9	27.0
1916	4.66	4.27	3.84	12.77	8.3	1.54	36.5	33.4	30.1
1917	6.07	5.86	5.13	17.06	13.9	1.22	35.6	34.3	30.1
Av'g.	4.91	4.54	3.86	13.31	12.5	1.06	36.9	34.1	29.0

Table XII presents a chronological record of wheat costs in Missouri for the years 1910 to 1917 inclusive. The general tendency for acre costs to increase from year to year as has already been discussed is also apparent and fairly uniform here.

Variations by Localities. Table XIII is another presentation of the variation in wheat costs by counties that was shown in Table IX. The extreme range is from \$13.93 per acre to \$38.25 per acre and from \$1.51 to \$6.30 per bushel. The highest costs per acre are to be found in the eastern part of the state and the lowest in the west. In the eastern section the northern counties show the highest cost whereas in the central and western sections the southern counties have the higher cost. The lowest bushel costs are to be found in the central section and the highest in the west.

Table XIII.  
 Variations in the Cost per Acre of Producing  
 Wheat in Kansas by Counties - 1918. (46).  
 (Survey Data).

County	Section of State	Labor Cost	Land Charge	Other Costs	Total Cost	Yield in bu.	Cost per bu.	Percentage Distribution of Costs.		
								Labor	Land	Other
								%	%	%
Doniphan	N.E.	12.00	15.45	10.80	38.25	19.72	1.94	31.4	40.4	28.2
Pottowotomie	N.E.	13.66	9.03	14.93	37.62	19.07	1.97	36.3	24.0	39.7
Cherokee	S.E.	13.59	5.48	12.60	31.67	17.71	2.24	27.8	26.9	45.3
Sedgwick	S.C.	10.18	8.97	11.55	30.70	19.37	1.58	33.2	29.2	37.6
Sumner	S.C.	10.98	6.31	13.15	30.44	17.84	1.72	36.1	20.7	43.2
Clay	N.E.	9.58	7.58	11.12	28.28	11.32	2.50	33.9	26.8	39.3
Harvey	S.C.	9.10	8.16	9.68	26.94	18.00	1.50	33.8	30.3	35.9
Jewell	N.C.	9.09	5.86	10.25	25.20	16.69	1.51	36.1	23.3	40.6
Ellis	N.C.	7.04	4.23	13.29	24.56	10.23	2.40	28.7	17.2	54.1
Barton	S.C.	6.71	6.50	10.94	24.15	10.79	2.24	27.8	26.9	45.3
Ford	S.W.	5.91	4.61	10.83	21.35	3.39	6.30	27.7	21.6	50.7
Thomas	N.W.	3.58	1.98	8.37	13.93	6.02	2.31	25.7	14.2	60.1
Average								31.5	25.2	43.3

Table XIV.

Variations in the Cost Per Acre of Producing  
Wheat in Kansas by Districts - 1919. (23).

(Questionnaire Data)

Section of State	C O S T S.				Yield per Acre	Cost per Bu.	Percentage Distribution		
	Labor Cost	Land Charge	Other Costs	Total Costs			Labor Cost	Land Charge	Other Costs.
North Eastern	7.34	12.00	17.13	36.47	16.2	2.25	20.1	33.0	46.9
South "	7.71	7.46	19.14	34.31	16.5	2.08	22.5	21.7	55.8
North Central	6.23	7.24	15.04	28.51	13.0	2.19	21.9	25.4	52.7
South "	5.50	7.31	11.84	24.65	11.0	2.24	22.3	29.7	48.0
North Western	4.78	3.31	12.89	20.98	12.25	1.71	22.8	15.8	61.4
South "	4.47	2.98	11.55	19.00	9.67	1.96	23.5	15.7	60.8
State Average	5.93	6.94	13.87	26.74	12.7	2.11	22.2	26.0	51.8

Table XIV shows the figures on wheat costs for Kansas in 1919. This year they are shown by sections instead of by counties as in 1918. The range in acre costs is from \$19.00 to \$36.47, and in bushel costs from \$1.71 to \$2.25. The smaller variation is due to the fact that larger areas were averaged together than in the previous table and hence the extreme variations tend to be obscured. A very distinct tendency for acre costs to decrease from east to west as noted in the previous table is again apparent. An equally distinct tendency for costs to decrease from north to south is shown. There is little uniformity in the variations in bushel costs except that they decrease from east to west very slightly.

Table XV.

Variations in the Cost of Producing  
Wheat by States - 1919. (47)  
(Survey Data)

State	Cost Per Acre	Yield Per Acre	Cost Per Bushel
Missouri	34.79	18.6	1.87
Nebraska	28.67	15.13	1.90
Kansas	24.99	13.41	1.86
Av'g. Winter Wheat	27.80	14.9	1.87
South Dakota	23.70	9.9	2.40
Minnesota	23.19	8.2	2.81
North Dakota	20.76	7.8	2.66
Av'g. Spring Wheat	22.40	8.4	2.65
Av'g. All Wheat	25.10	11.7	2.15

Table XV presents the variations in wheat costs between different states in 1919. A much wider variation in acre costs is noted between the winter wheat states than between the spring wheat



Table XVI.  
 Variations in the Percentage Distribution of  
 Wheat Production Costs on Six Minnesota Farms  
 1913- 1917.\* (45).

Farm	Year	Labor Cost	Land Charge	Other Costs
		%	%	%
No.1	1913	36.8	34.8	28.4
	1914	22.3	44.2	33.5
	Average	29.9	39.3	30.8
No.2	1913	38.8	23.9	37.3
	1914	41.8	26.5	31.7
	1915	40.6	21.6	37.8
	1916	39.1	19.3	41.6
	1917	45.5	20.1	34.4
	Average	41.2	21.9	36.9
No.3	1914	28.7	41.1	30.2
	1915	34.1	32.2	33.7
	1917	34.9	28.2	36.9
	Average	33.0	32.8	34.22
No.4	1913	26.0	45.9	28.1
	1914	25.6	45.2	29.2
	1915	20.5	27.9	51.6
	1916	25.3	35.0	39.7
	1917	24.3	33.0	42.7
	Average	24.0	36.2	39.8
No.5	1913	20.3	48.8	30.9
	1914	24.9	45.5	29.6
	1915	21.1	37.1	41.8
	1916	17.4	40.5	42.1
	1917	26.4	33.9	39.7
	Average	22.3	40.2	37.5
No.6	1914	31.6	41.4	27.0
	1915	24.1	39.4	36.5
	1916	24.0	38.8	37.2
	1917	24.3	37.0	38.7
	Average	25.9	39.1	35.0
Average	All	29.1	35.1	35.8

\* Data from Table IV.

states. The winter wheat acre costs are distinctly higher than the spring wheat costs. The reverse is true of the bushel costs. The spring wheat bushel costs are considerably higher than the winter wheat costs and fluctuate more widely.

#### Percentage Distribution of Costs.

Table XVI shows the relative percentage that the items of labor cost, land charge and other costs constitute of the total acre costs of wheat production as shown in Table VII. This use of percentages serves to eliminate price variations and makes possible a much more accurate comparison between the several items of cost than is possible when only the cash values are shown. It makes possible a comparison between these different factors of cost as to their relative importance. There is some uniformity as to percentage distribution on an individual farm from year to year but a considerable variation between different farms.

Table XVII.

Variations in the Percentage Distribution  
of the Factors of Acre Cost in Wheat  
Production.\*

Locality.	Year.	Percentage of Total Cost.		
		Labor Cost	Land Charge	Other Costs.
Minnesota (28)	1913-1917	29.1	35.1	35.8
North Dakota (29)	1907-1912	20.9	28.3	50.8
Kansas (46)	1918	31.5	25.2	43.3
Kansas (23)	1919	22.2	26.0	51.8
Missouri (20)	1910-1917	36.9	34.1	29.0
Average Percentage		28	30	42

\*Data from Tables XI, XII, XIII, XIV, & XVI.

Tables XI, XII, XIII, and XIV, also present the percentage variations in the factors of cost. The averages of these tables are summarized in Table XVII together with the averages of Table XVI. The greatest variation is to be noted in other costs. This is largely due to the fact that this item contains a number of factors of cost that are not uniformly handled by different investigators and that in themselves may be quite variable. The land cost is the least variable. Roughly speaking the labor cost and land charge constitute about thirty percent each of the total cost of wheat production and other costs the remaining forty percent.

#### Variations in Labor Cost.

Variations in Total Costs. In the previous tables the labor cost of wheat production has been shown to vary from \$1.63 per acre at Bathgate, N.D. in 1910 to \$13.66 in Pottawatomie County, Kansas, in 1918. Within the state of Kansas in 1918 it varied from \$3.58 per acre in Thomas County to \$13.66 in Pottawatomie County. Tables VII, XI, and XII, shows the labor costs to increase from year to year up to 1917, due largely to a rise in the wages of farm help.

Variations in Hours of Labor. Table XVIII presents the variations in the hours of labor required to produce an acre of wheat in a number of different localities and for different years. Man hours vary from 5.2 per acre to 23.1 hours and horse hours from 16.75 to 39 hours per acre. The eastern states show a much higher labor requirement than do the western. This is due in part to the fact that as a rule, fields are smaller, more irregular in shape, often hilly or stony and cannot be worked with the facility of large

Table XVIII.

Variations in the Hours of Labor Required per Acre  
in Wheat Production.

State	Locality	Year	Man Hours	Horse Hours	Ratio of Man to Horse Hours.
West Virginia (17)	5 Counties	1913-15	23.10	33.60	1:1.5
Pennsylvania (3)	Chester Co.	1915	20.40	39.0	1:1.9
Minnesota (28)	Wright Co.	1913-17	18.97	36.21	1:1.9
Minnesota (7)	Rice Co.	1906-12	14.47	28.00	1:1.9
Minnesota (28)	Norman Co.	1913-17	13.97	36.47	1:2.6
Missouri (20)		1910-17	12.76	24.91	1:2.0
Minnesota (7)	Lyon Co.	1902-10	12.21	29.41	1:2.4
Missouri (18)	State Av'g.	1920	11.00	24.92	1:2.3
Minnesota (7)	Norman Co.	1902-12	10.77	20.25	1:2.6
Montana (8)	Gallatin Valley	1914-15	10.34	30.77	1:3.0
Montana (8)	Judith Basin	1914-15	8.81	28.85	1:3.3
Minnesota (47)	Traverse Co.	1919	8.80	25.70	1:2.9
Kansas (23)	State Av'g.	1919	8.28	24.83	1:3.0
Minnesota (47)	Clay Co.	1919	8.20	22.4	1:2.7
North Dakota (41)	Morton Co.	1919	7.90	20.80	1:2.6
North Dakota (41)	Grand Forks Co.	1919	5.20	16.75	1:3.2



regular clear fields. It is further due to difference in methods of handling the crop. Wheat in the eastern states is usually either stacked or hauled into the barn to be threshed. This requires more labor than where wheat is threshed from the shock or where it is harvested by a combined harvester and thresher as is common in some of the western states. A proportionately large use of machinery and horse labor results in a saving of man labor. The last column in Table XVIII shows an important factor in labor economy - the substitution of horse labor for man labor by the use of larger horse power units. For example, Missouri, in 1920, cuts down the man hours per acre over the previous years by one and three quarters hours without any increase in horse hours by increasing the ratio of horse hours to man hours from 2 to 2.3. A similar comparison may be made between Missouri in 1920 and Kansas in 1919. By increasing the horse hours per man hour from 2.3 to 3 the man labor is cut two hours per acre and the horse hour remain practically the same. The use of larger sized machinery is also a factor in this economy.

Table IIX.

Variations in the Hours of Man Labor per Acre. (45).

on Six Minnesota Farms, 1913-1917.

(Cost Account Data)

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Average All Farms
1913	+10.6	+11.80		-10.0	-7.90		10.08
1914	- 6.24	+12.01	- 7.66	+10.22	-9.02	+13.32	9.75
1915		+13.15	- 9.61	+12.46	-10.01	-10.75	11.20
1916		+10.37		- 8.78	- 6.09	+11.95	9.30
1917		- 9.08	- 8.35	+10.37	- 9.00	+10.15	9.39
Av'g.	-8.42	+11.28	- 8.54	+10.37	- 8.40	+11.53	9.76

Table XX.

Variations in the Hours of Horse Labor per Acre  
on Six Minnesota Farms, 1913-1917. (45).  
(Cost Account Data).

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Av'g. All Farms.
1913	-23.80	+28.75		-24.20	-18.60		23.84
1914	-19.44	+28.12	-14.73	+22.83	-20.19	+29.64	22.46
1915		+32.79	-18.07	-21.77	+23.41	-19.01	23.01
1916		+32.35		-22.27	-14.02	-21.09	22.43
1917		+27.96	-21.11	-20.58	+23.35	-16.70	21.94
Av'g.	-21.62	+29.99	-17.97	+22.33	-19.91	-21.61	22.24

Tables XIX and XX present an interesting study in the variations in hours of labor per acre. A considerable variation is noted on the same farms in different years and between different farms the same year. It is particularly significant that, especially in the case of man labor, the same farms are found either above or below the average quite consistently. For example, the man hours on Farm 2 are higher than the average four years out of five, and on Farm 5 are lower than the average every year. Farm 2 is higher than the average in horse hours every year while Farm 5 is just below the average. It is apparent that the system of farm organization, the type of soil, and the quality or efficiency of labor on any given farm are fairly fixed and remain comparatively constant from year to year in their effect on labor variations. Some farms are so organized or managed as to be characteristically high in labor requirements for wheat production and others similarly low.

Table XXI.

Variations in the Man Labor Rate on Six  
Minnesota Farms, 1913-1917. (45)

(Cost Account Data)

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Av'g. All Farms.
	cents	cents	cents	cents	cents	cents	cents
1913	+18.31	-15.53		-15.11	-14.03		15.75
1914	+15.57	+15.49	-13.50	-13.24	+16.94	-14.52	14.88
1915		+18.98	+16.98	-12.14	-15.20	+17.18	16.10
1916		+18.25		-16.35	+18.56	-14.97	17.03
1917		+17.68	+17.29	-15.05	+19.92	-14.04	16.79
Av'g.	+16.94	+17.19	-15.92	-14.38	+16.93	-15.18	16.02

Table XXII.

Variations in the Horse Labor Rate on Six  
Minnesota Farms, 1913-1917. (45)

(Cost Account Data)

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Av'g. All Farms.
	Cents	cents	cents	cents	cents	cents	
1913	+ 9.26	+ 8.61		+ 8.81	- 6.85		8.38
1914	- 7.62	- 8.88	- 8.77	+12.71	+ 9.67	- 8.77	9.34
1915		- 8.28	+10.63	+14.35	- 8.30	- 8.87	10.09
1916		+12.07		+14.39	-11.37	- 8.71	11.64
1917		+17.75	-14.86	+15.81	-15.47	-14.71	15.72
Av'g.	- 8.44	+11.12	+11.42	+13.21	-10.33	-10.27	10.80

## Variations in Labor Rates.

Tables XXI and XXII present the second variable factor in labor cost variations, the cost of man and horse labor per hour.. It will be noted that just as some farms are characteristically high or low in acre labor requirements, just so they are uniformly high or low in labor rates. The variations in man labor rates are

due to two factors, rate of wages paid per day or month and number of hours worked per period. For example, in 1917 the average length of working day on Farm 5 was 8.49 hours and the rate per hour was 19.92 cents. (45). On Farm 6 in the same locality and paying only slightly lower wages per day, the average length of working day was 11 hours and the rate per hour was only 14.04 cents. (45). The effect of higher wages is reflected in the higher rates in 1916 and 1917 over the previous years.

Likewise the horse rate is affected by two factors - the cost of keeping a horse for a year and the hours of labor performed per horse annually. The horses that average the largest number of hours of labor performed during the year provide labor at a lower rate per hour. This is brought out by Table XXIII.



Table XXIII.

Relation of Hours of Labor Performed Annually and  
Total Annual Cost per Horse to Cost per Hour of  
Horse Labor on Six Minnesota Farms, 1913-1917. (45).  
(Cost Account Data).

Year	Lowest Cost.			Highest Cost.		
	Hrs. work performed annually per horse	Total Horse Costs per head annually	Cost per hr. of Labor	Hrs. work performed annually per horse	Total Horse costs per head annually	Cost per hr. of labor
1913	1355	92.82	6.85	1138	105.38	9.26
1914	1581	120.47	7.62	1175	149.34	12.71
1915	1175	97.29	8.28	1027	147.37	14.35
1916	1522	133.48	8.71	1475	212.25	14.39
1917	1416	198.81	14.04	1170	233.06	19.92

There is a wide difference in methods of handling horses on the different farms. It is surprising to note that those farms which show the lowest horse labor rate per hour not only work the horses more hours annually but actually keep the total annual costs of feeding and caring for those horses below that on the farms having a high horse rate. The efficient use of horse labor so as to make as complete a utilization of their time as possible together with economy in costs of feed and care are the main items in lowering horse labor rates. It is apparent from Tables XX and XXII that a low cost per hour of horse labor does not mean less effective labor since Farm 6 has a horse rate below the average for all four years and yet the hours of labor required to produce an acre of wheat average lower than the other farms. Similarly the high rate horse labor on Farm 2 requires more hours per acre than any of the farms having a lower rate. Apparently there is a possibility of a much more economical and effective use of horse labor.

production is land rent or a charge for the use of land. This item composes about 30% of the total cost of production. The extreme range of variation in land charge is fully as great as in case of labor. In the studies presented in tables previously discussed it ranges from \$1.98 per acre in Thomas County, Kansas, to \$15.45, per acre in Doniphan County, Kansas, in 1918. It varies from one-seventh to one-half of the total cost. While the land charge varies considerably in different sections of the state as shown by Table XIII, the variation on the same farms for a period of years is small. This latter fact is apparent from Table XII. Table XXV further illustrates this point very clearly.

Table XXV.

Variations in Land Cost per Acre

On Six Minnesota Farms, 1913-1917. (45)

(Cost Account Data)

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Av'g. All Farms
1913	\$ -3.92	\$ -2.66	\$	\$ +6.44	\$ +5.97	\$	\$ 4.75
1914	-4.41	-2.75	-3.32	+6.86	+5.86	+5.93	4.85
1915		-2.78	-3.35	+6.31	+6.07	+5.77	4.86
1916		-2.87		+6.40	+6.31	+5.85	5.36
1917		-2.91	-3.70	+6.53	+6.93	+5.91	5.20
Av'g	-4.17	-2.79	-3.42	+6.51	+6.23	+5.87	4.83

Every farm throughout the five years maintains its relative rank quite consistently and varies little from year to year. The extreme variation is \$1.07 per acre or only 18 percent, whereas there was a variation in labor cost of 32 percent on that farm and as high as 100% on others. In this way the land charge differs from either labor cost or other costs since both of these items may vary widely from year to year on the same farm.

Table XXVI.

Relation of Value of Land to Land Charge  
on Six Minnesota Farms, 1913-1917. (45).

(Cost Account Data)

Number of Farm	Land Value per Acre	Land Charge per Acre.
2	\$40.00	\$2.79
3	50.00	3.42
1	57.00	4.17
5	87.00	6.23
6	90.00	5.87
4	95.00	6.51

Table XXVII.

Relation of Value of Land to Land Charge  
in Twelve Kansas Counties - 1918. (46).

(Survey Data).

County.	Value of Land per Acre	Land Charge per Acre
Thomas	\$24.77	\$1.98
Ford	56.82	4.61
Ellis	64.65	5.45
Cherokee	67.28	5.48
Jewell	72.40	5.86
Sumner	77.98	6.31
Barton	80.65	6.50
Clay	91.47	7.58
Harvey	101.33	8.26
Pottawatomie	111.09	9.03
Sedgwick	111.60	8.97
Doniphan	191.55	15.47

Causes for Variations in Land Charge. Tables XXVI and XXVII present the cause for the variations in land charge. The land charge is based on the value of the land and whether it represents the actual cash rental value of the land or is computed on the basis of the interest earning capacity of the money value of the land, the basis is fundamentally the same. In the studies from which these figures were obtained the land charge consists of interest on the sale value of the land at current mortgage rates plus the actual cash payment per acre for taxes. Hence it follows that the land charge is directly proportional to the value of the land. There are slight variations as in case of Farms 5 and 6 in Table XXVI. The higher tax on Farm 5 results in a higher land charge per acre than prevails on the slightly higher priced land on Farm 6. In general, however, the land charge fluctuates directly with the value of the land and it is the only one of the production costs that can be readily and positively computed in advance of production and without the keeping of any records. Only in case share rent is used as the basis for land charge does this item vary materially from year to year. In that case it fluctuates directly with the yield. Since the higher priced wheat lands usually return larger yields per acre-since the price is based, in part at least, on production value - a tendency for the land charge to vary with the value of the land per acre is still apparent but fluctuates much more from year to year.

#### Variations in Other Costs.

The third division of wheat production costs has already been referred to and defined as "other costs." It is really a composite of a group of separate items. It is not strange then that since it is composed of a number of variable items and since the number of these items included varies in different studies and with different



systems of farming, that this composite should be the most variable of all the cost groups. The extreme range in the tables presented is from \$2.44 on Farm 3 in 1914 (Table VII) to \$19.14 in southeastern Kansas in 1919 (Table XIV). The range in percentage of total costs is from 27% to 61.5% with an average of 42%.

Variations in Items of Other Costs. Table XXVIII presents the variation in items of other costs by farms and years for the six Minnesota farms. The causes of variations in these factors have already been discussed. It is to be observed that the manure and overhead charges are the most variable. There is a wide variety in farm practice as to manure application in wheat production. In Minnesota it is very seldom applied directly to the wheat ground. Usually the manure charge in this table is a residual charge brought forward from an application to some previous crop on the same ground. Overhead is composed of widely varying factors and varies accordingly.

Table XXIX presents a comparison of the total other costs on these same six Minnesota farms by years. The same tendency is noted here as was the case with labor costs and land charges. Each farm is characteristically high or low as regards other costs. Here again the system of farm organization, the soil and other individualistic farm conditions determine the farms relative rank.

Table XXVIII.

Variations in Other Costs per Acre on Six

Minnesota Farms, 1913-1917. (45).

(Cost Account Data)

Farm	Year	Seed Cost	Twine Cost	Thresh- -ing Cost	Mach- -inery Cost	Manure Costs	Over head charge	Total other costs
Farm 1	1913	1.11	.18	.89	.60		.42	3.20
	1914	1.33	.23	1.05	.48		.25	3.34
	Av'g.	1.22	.21	.97	.52		.34	3.26
Farm 2	1913	1.45	.16	.91	.29	.25	1.09	4.15
	1914	1.19	.17	.54	.47	.30	.62	3.29
	1915	1.76	.17	.81	.53	.39	1.20	4.86
	1916	1.43	.17	.56	.59	2.16	1.27	6.18
	1917	2.42	.17	.64	.30	.50	.94	4.97
	Av'g.	1.65	.18	.69	.44	.72	1.02	4.70
Farm 3	1914	1.02	.19	.60	.23		.40	2.44
	1915	1.46	.24	1.10	.27		.44	3.51
	1917	2.38	.19	.69	.43	.70	.44	4.86
	Av'g.	1.62	.22	.80	.34	.23	.43	3.64
Farm 4	1913	1.26	.26	.61	1.14		.68	3.95
	1914	1.20	.25	.64	1.14	.71	.50	4.44
	1915	3.41	.23	.89	.68	4.63	1.84	11.68
	1916	1.98	.30	.75	.79	2.12	1.33	7.27
	1917	2.66	.49	1.59	1.38	1.31	1.05	8.48
	Av'g.	1.90	.31	.90	.81	1.75	1.08	7.15
Farm 5	1913	1.23	.26	.69	.56		1.02	3.76
	1914	1.53	.24	.59	.64	.31	.50	3.81
	1915	2.11	.21	1.15	.35	2.58	.43	6.83
	1916	1.80	.11	.71	.49	2.25	1.16	6.52
	1917	3.15	.37	1.46	1.07	1.79	.28	8.12
	Av'g.	1.98	.24	.92	.60	1.39	.68	5.81
Farm 6	1914	1.25	.32	.95	.71		.63	3.86
	1915	1.45	.23	.69	.61	1.88	.48	5.34
	1916	1.62	.35	1.07	.55	1.13	.85	5.57
	1917	2.86	.30	1.66	.40	.58	.40	6.20
	Av'g.	1.80	.30	1.08	.57	.90	.59	5.24

Table XXIX.

Variations in Other Costs per Acre on  
Six Minnesota Farms, 1913-1917.(45).

(Cost Account Data)

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Av'g. All Farms.
1913	-3.20	+4.15		+3.95	-3.74		3.76
1914	+3.34	-3.29	-2.44	+4.44	+3.81	+3.86	3.53
1915		-4.86	-3.51	+11.67	+6.83	-5.34	6.44
1916		-6.18		+ 7.28	+6.56	-5.60	6.40
1917		-4.97	-4.86	+ 8.42	+8.12	-6.20	6.51
Av'g.	-3.27	-4.69	-3.60	+ 7.17	+5.81	+5.25	4.97

Table XXX.

Variations in Bushels of Seed per Acre  
on Six Minnesota Farms, 1913-1917. (45).

(Cost Account Data)

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Av'g. All Farms.
	bus.	bu.	bu.	bu.	bu.	bu.	bu.
1913	-1.25	+1.86		+1.63	+1.59		1.58
1914	+1.56	-1.40	-1.20	-1.37	+1.74	-1.38	1.44
1915		-1.17	-1.08	+2.27	1.51	-1.50	1.51
1916		-1.19		+1.58	+1.50	+1.49	1.44
1917		-1.21	- .99	+1.33	+1.50	+1.50	1.31
Av'g.	-1.41	-1.37	-1.09	+2.05	+1.57	-1.47	1.49

Rate of Seeding. Table XXX shows the range in bushels of seed sown per acre on the six Minnesota farms for the five year period. A rather surprising variation from year to year on the same farm is apparent. The farms further north and west, Farms 1,2, and 3 where wheat is a major crop show a distinctly lighter seeding per acre than those in Renville County where wheat is a relatively less

important crop. There is also a tendency to decrease the rate of seeding during the last two years as the seed became higher in price.

Table XXXI.

Variations in Twine used per Acre

On Six Minnesota Farms, 1913-1917. (45).

(Cost Account Data)

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Av'g. All Farms
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1913	-1.64	-1.62		+2.45	+3.07		2.20
1914	+2.59	-1.75	-2.10	+2.63	+2.51	+3.43	2.50
1915		-2.25	-2.50	+3.27	+3.00	+2.92	2.79
1916		-1.80		+3.16	-1.32	+3.94	2.56
1917		-1.31	-1.58	+3.06	+2.75	-1.98	2.14
Av'g.	-2.12	-1.69	-2.06	+2.91	+2.53	+3.07	2.40

Twine Consumption. Table XXXI shows the range in amounts of twine used per acre in wheat production on the six Minnesota farms. It is very noticeable that on Farms 4,5, and 6 where the heavier seeding was noted, the twine requirements are higher. Apparently the heavier seeding produces a ranker growth of straw which requires more twine. This heavier growth of straw is a distinct asset in Renville county where considerable livestock is kept, and may account for the heavier seeding. Farms 1,2, and 3 are located in a grain growing area where comparatively little livestock is kept and hence straw has less value.

Relation of Yield to Seed & Twine Requirements. In Table XXXII we have a comparison between the rate of seeding, twine requirement, and yield as reported by various studies. The range in bushels of seed per acre is from .8 of a bushel in the Judith Basin



Montana, to 1.54 bushels in Pottawatomie County, Kansas. The lighter seeding is noted in the drier or semi-arid sections, especially where "dry farming" practices prevail. In the more humid areas where the moisture is sufficient to support a ranker growth of straw a heavier seeding is noted. No relation between rate of seeding and yield is apparent. The amount of twine used per acre, however, bears a distinct relation to the yield per acre. In general it is directly proportional to the yield. The heavier growth of straw that accompanies the higher yield requires more twine. There are some exceptions to this rule as is illustrated in case of Clay and Traverse Counties, Minnesota, in 1919. Although the yield is low the twine used is about the same as that in Norman County, Minnesota, 1913 to 1917, with more than twice the yield. This is accounted for by the fact that there was a heavy growth of straw in Clay and Traverse Counties in 1919 but the yield was cut down by an epidemic of wheat scab and black stem rust that prevented normal filling of the heads. Without this unfortunate circumstance the yield would have been in proportion to the heavy straw yield. As a result of the disease epidemic not only the yield but the quality as well was cut.

#### Variations in Yields.

Another important factor in variations in wheat production costs is yield. Yield per acre is one of the most variable of all factors in production costs and one that is dependent on a wide variety of conditions and circumstances. Table IX shows that there was a range in the State of Kansas in 1918 of from one to thirty-five bushels per acre and in one county, Jewell, from nine and one-half to thirty five bushels. The county averages varied from 3.4 bushels in Ford County to 19.7 bushels in Doniphan County.

Table XXXII.

Relation of Yield to Seed & Twine Used Per Acre  
in Wheat Production.

Locality.	Year.	Yield bu.	Seed bu.	Twine lbs.
North Dakota (41)	1919	7.0	1.14	1.84
Clay Co., Minn. (47)	1919	8.1	1.36	2.21
Traverse Co., Minn. (47)	1919	8.4	1.41	2.00
Clay Co., Kansas (46)	1918	11.3	1.33	1.36
Missouri (18)	1920	12.8	1.25	1.50
North Dakota (12)	1913-15	13.2	1.20	1.78
Norman Co., Minn. (28)	1913-17	17.2	1.46	2.14
Cherokee Co., Kan. (46)	1918	17.7	1.35	2.37
Sumner Co., Kan. (46)	1918	17.8	1.14	2.58
Wright Co., Minn. (28)	1913-17	17.9	1.37	2.05
Pottawatomie Co., Kan. (46)	1918	19.1	1.54	2.55
Doniphan Co., Kan. (46)	1918	19.7	1.44	2.04
Judith Basin, Mont. (8)	1914-15	28.4	1.00	3.10
Gallatin Valley, Mont. (8)	1914-15	34.7	.80	3.20

Table XXXIII.

Relation of Yield to Cost per Acre and Cost  
per Bushel in Twelve Kansas Counties,  
1918. (46).

(Survey Data).

County.	Cost Per Acre	Yield Per Acre Bu.	Cost Per Bus.
Doniphan	\$38.25	19.72	\$1.94
Sedgwick	30.70	19.37	1.58
Pottawatomie	37.62	19.07	1.97
Harvey	26.94	18.00	1.50
Sumner	30.44	17.84	1.72
Cherokee	31.67	17.71	1.79
Jewell	25.20	16.69	1.51
Clay	28.28	11.32	2.50
Barton	24.15	10.79	2.24
Ellis	24.56	10.23	2.40
Thomas	13.93	6.02	2.31
Ford	21.35	3.39	6.30

Yield per acre has a much more striking effect on bushel costs than it has on acre costs. Table XXXIII shows the relation between yield per acre and costs per acre and per bushel in twelve Kansas Counties in 1918. In general acre costs vary directly with the yield though not in the same proportion, and bushel costs vary inversely. This relation is not apparent when the variation is slight but is very noticeable when there is much difference in yield. The bushel cost-yield relation is much more fixed than is the acre cost-yield relation.

Table XXXIV.

Relation of Yield to Cost per Acre  
and Cost per Bushel in Missouri, 1920. (18).

Cost Per Acre	Yield Per Acre	Cost Per Bu.
	Bu.	
\$22.87	6	\$3.81
24.46	8	3.06
26.57	10	2.65
28.26	12	2.35
29.94	14	2.14
31.62	16	1.97
33.32	18	1.85
34.47	20	1.72
36.11	22	1.64
37.75	24	1.57
39.38	26	1.51
41.16	28	1.47
42.81	30	1.42

Table XXXIV further illustrates the effect of yield on costs. The lowest yields, even with the low acre costs, result in a high bushel cost whereas the higher yields, in spite of the higher acre costs, result in a low bushel cost.

Table XXXV.

Relation of Yield per Acre to Cost per Bushel on

Six Minnesota Farms, 1913-1917. (45).

(Cost Account Data).

1913		1914		1915		1916		1917	
Yield per Acre	Cost per bu.	Yield per Acre	Cost per bu.	Yield per Acre	Cost per bu.	Yield per Acre	Cost per bu.	Yield per Acre	Cost per bu.
bu.	\$	bu.	\$	bu.	\$	bu.	\$	bu.	\$
24.30	.46	16.26	.61	20.91	.78	13.35	1.13	29.96	.53
17.70	.79	15.76	.91	18.30	.57	10.81	1.69	22.69	.90
17.25	.64	10.50	1.45	14.80	1.53	7.10	2.20	21.70	.91
13.86	.88	10.38	1.24	13.75	1.07	5.72	2.60	10.94	1.32
		9.30	.87	12.94	.99			9.92	1.32
		8.95	1.16						

Table XXXV illustrates the effect of yield on bushel cost as far as the six Minnesota farms are concerned. The highest yields in every year but one result in the lowest bushel costs, and a general tendency for bushel costs to increase as yields decrease is further apparent.

The reason for the relation just pointed out between yield and bushel and acre costs is best brought out by an analysis of the different factors of cost and their relation to yield. Most of the labor on the wheat crop is the same regardless of yield. It takes just as long to plow, prepare the seed bed, and sow an acre yielding ten bushels of wheat as it does to till an acre that may yield twenty or thirty bushels. More thorough tillage and soil preparation may raise the yield somewhat but wheat growing practices in any community are fairly standardized and represent in a general way, the most profitable methods for that community. The only increase in acre labor costs due to increased yields comes in the slightly higher cost of cutting, shocking, and hauling the extra crop. The item of land rent, for any individual farm, except in



case of share rent, is not affected by the yield. Of course land values and hence land charges are based, in part at least, on the production possibilities of the soil and the higher priced land usually yields heavier but this is not a fixed rule at all and does not apply to the yield variations on an individual farm.

Of the items of other cost, seed, as has been already pointed out, is not affected by yield. The twine as has already been shown in Table XXXII is directly proportional to the yield and the same thing is true of the threshing cost since it is based on a bushel rate. Both of these are, however, minor items of cost. The machinery cost for the higher yields is not appreciably higher. The fertilizer costs may be higher for the higher yields in so far as those higher yields are the result of fertilizer application. Insurance and crop risk are usually even higher in case of the lower yielding areas than in those returning average or better than average yields. Those conditions that make for low yields such as lack of moisture, unproductive soil, and the various crop hazards make the crop less certain as well as low in yield. It is also worthy of note in this connection that where low yields are due to a disease epidemic, insect damage, frost, hot winds, storms, hail, or some similar crop hazard, the quality of the grain is low as well as the yield. High yields, on the other hand, usually imply a good quality of grain. Since production costs do not increase proportionately with yields - that is, since a high yield does not cost proportionately more than a low one, it is apparent that yield is a very important factor in cost variations, especially as it concerns the bushel cost.

#### EFFECT OF FACTOR VARIATIONS ON TOTAL COST.

##### Effect of Labor Cost Variations.

Labor has already been shown to be one of the most variable of all items of cost. It varies widely between farms in a given locality and between different years on the same farm. It varies also between localities and between States. This variation is due to a wide variety of factors - soil conditions and ease of working, community farming practices, the organization of the individual farm, labor efficiency, rate of wages, cost of horse feed, weather conditions, farm layout, farm equipment, and other factors of that nature. In general the lower priced lands are worked at the lowest cost for labor and the highest priced lands at the highest labor cost. This variation is, however, due in part, at least, to the difference in yields on the high and low priced lands. The labor cost is more nearly under the farmer's control than either land or other costs and hence offers the largest opportunity to decrease the total acre cost.

#### Effect of Land Charge Variations.

Land charge is the one factor of wheat production costs that is relatively fixed and not under the farmer's immediate control. It is usually based on a fixed land value and hence not subject to seasonal fluctuations. The land cost, however, varies between different localities within a State and between different states. We have already noted a range among the different counties in Kansas in 1918 from \$1.98 in Thomas County to \$15.45 in Doniphan County where the land values are \$24.77 and \$191.55 per acre respectively. In Montgomery County, Iowa, we find the land charge for wheat production in 1920 as high as \$19.96 per acre on \$337.00 land. (47). In other words the land charge in some localities is greater than the total of all production costs in others. In so far as the higher land charge is expressive of greater productivity

it affects only the acre cost. A high yield on high priced land may result in a low bushel cost in spite of the high land charge. In the Iowa study just referred to the total acre cost of wheat production was \$38.02, but a yield of 21.7 bushels per acre resulted in a bushel cost of \$1.75. In Wapello County where land was worth \$270.00, per acre and the land charge was \$16.05, the total cost was \$35.23 but a yield of 17 bushels per acre resulted in a bushel cost of \$2.07. (47). The land charge is one that is practically fixed by influences outside the farmer's control and hence not one that can be considered in a study designed to decrease the costs on an individual farm. It can only be considered in the decision between two areas of differing land values in determining their relative profitability for wheat production.

#### Effect of Other Cost Variations.

The miscellaneous costs of wheat production, like the land charge, are not entirely under the farmer's control. The seed cost is determined largely by agronomic conditions and seed prices. Twine and threshing costs are determined by yield. The machinery charge can be somewhat decreased by careful handling and care of the machinery but it is a small item at best. The crop risk or insurance charge is determined by climate and by the attendant crop hazards. The fertilizer charge is the only one that the farmer may vary at will or eliminate entirely. The overhead charges are partly within the farmer's control since an efficient use of labor will decrease the amount of non-productive or overhead labor and hence reduce this cost. In general it will be seen that the other costs of wheat production are fairly fixed in so far as their effect on the total cost is concerned and offer comparatively little opportunity for cost reduction.

### Effect of Yield Variations.

The effect of varying yields on production costs has already been discussed. Generally speaking, higher yields result in higher acre costs but lower bushel costs. Of course this would not be true if the increased yields were due to more intensive cultivation beyond the point of diminishing returns. However, wheat farming practices are so standardized as to degree of intensity of cultivation in any given locality that the point of diminishing returns is not often reached.

### Combined Effect of Factor Variations.

The combined effect on total cost of variations in the three factors of wheat production cost is illustrated in Table XXXVI.

Table XXXVI.

Effect of Variation in Factors of Cost in Wheat  
Production on Total Cost on Six Minnesota Farms,  
1913-1917. (45).

Farm or Number	Labor and Cost Charge	Land Charge	Other Costs	Total Cost	Yield in bu.	Cost per bu.
5	-3.48	-3.42	-3.60	-10.50	-12.51	- .84
1	-3.19	-4.17	-3.27	-10.63	+20.28	- .52
2	+5.24	-2.79	-4.69	-12.72	-11.16	+1.14
6	-3.89	+5.81	+5.25	+14.95	+18.21	- .82
3	-3.45	+6.23	+5.81	+15.49	-14.99	+1.03
4	+4.32	+6.51	+7.17	+18.00	-15.10	+1.19
Av'g.	3.93	4.82	4.97	13.72	15.38	.92

On Farms 1 and 5 where all three factors are low the total acre cost is low. On Farm 2 where the labor cost is above the average but the land charge and other costs are below, the total acre



cost is low. On farms 3 and 6 the labor costs are below the average but the land charge and other costs are above and the net result is a higher than average acre cost. On Farm 4 all three cost factors are higher than the average and of course the total cost is also high. This table not only illustrates the importance of studying the combined effect of the separate variables but indicates the distinct relation already referred to, namely, that the low costs are found grouped together as are also the high costs. It further shows that the relation between land charge and other costs is more fixed than that between labor cost and either of the other items. Labor cost fluctuates more widely above and below the average without much relation to either of the other factors. The effect of yield is also shown in this table. With low acre costs a low bushel cost may be obtained even with a sub-average yield as shown by Farm 5. Farm 6 with a higher than average acre cost shows a sub-average bushel cost on account of the high yield. The super-average acre cost with a sub-average yield naturally results in a super-average bushel cost as shown in case of Farms 3 and 4.

#### APPLICATION OF COST VARIATIONS TO FARM ORGANIZATION.

A study of the variations in the cost of wheat production and of variations in the factors that compose these costs brings out some facts in regard to farm organization and point out some possibilities of decreasing the costs by adjusting the farm organization. As has been pointed out, cost data are valuable to the individual farmer in the organization of his farm and the selection of enterprises. It has been shown that some farms are characteristically high in total costs or in some factor of cost whereas

others are correspondingly and consistently low. Cost data and factor variation data are useful in studying the methods of these low cost producers with a view to their adoption by the men producing at a high cost. It must be remembered that the factors of efficiency and economy that characterize the low cost farms and their system of organization do not apply to the wheat crop alone in most cases, but are outstanding features of the farm layout and organization and of the system of operation, and effect cost economies in other lines of production as well.

#### Importance of Long Time Average.

The wide variations in costs and returns from year to year indicate that in order to apply cost data to the selection of enterprises the data covering a period of years must be available. For example, we can see by referring to Table VII that if either of the years 1913 or 1915 were singled out, wheat might appear a very profitable crop since the bushel cost was unusually and consistently low these two years. On the other hand the year 1916 shows the highest bushel cost of the five-year period on each of the farms represented and might show up the wheat crop in a very unfavorable light if this year was to be taken as a criterion. It is only on the basis of a long time average that one can accurately pick those crops for any given farm or set of conditions.

#### Economy of Large Scale Production.

Another fact in regard to production costs brought out by these variations is the economy of large scale production. This is well illustrated in Tables IV and V. A larger percentage of the total production is produced at the lower costs. The cumulative percentage of total production is greater for these lower costs than is

the cumulative percentage of farms. It will be noted from Table IV that those farms in Keith County producing at a cost of \$1.50 per bushel amounted to only 43.5% of the whole number but produced 55.6% of the total production. In Phelps County only 56.7% of the farms produced at the average cost, \$2.40 per bushel, but they furnished 76.4% of the total production.

Table V presents a similar situation. In Clay County 50% of the farms produce at less than the average cost and include 71.9% of the total production. More of the large farms are to be found in the groups producing at less than average cost, whereas the smaller farms are more frequently found in the high cost groups. The farm organized for large scale production seems to effect an economy in cost by its large scale methods.

#### Labor Cost & the Farm Organization.

Labor has already been pointed out to be one of the most variable factors of cost and yet the one most nearly within the farmer's control. Unfortunately the data available is not sufficiently detailed to make possible a thorough analysis of labor efficiency. Table XVIII presents one factor in labor economy, - the replacing of man labor with horse labor or the increased efficiency of man labor when coupled with larger sized power units. The efficiency of large scale production in effecting economy of labor is shown by this same table. A comparison between Rice and Wright Counties, Minnesota, where wheat production is a comparatively minor enterprise and the acreage per farm is small, and Grand Forks or Morton Counties, North Dakota, where wheat is a major enterprise and large acreages are devoted to its culture, shows a large labor economy in favor of the latter counties. Other factors such as size and shape of fields and their distance from the farm-

stead are undoubtedly important factors in determining labor requirements that are at least partially under the farmer's control but there is nothing in these data to substantiate this very obvious conclusion.

The variations in labor rates suggest another possibility for economy in labor costs. By so organizing the farm as to employ labor the year around this labor can be more cheaply hired. The average wages for day help in Minnesota during harvest was \$6.10, and for month help throughout the year \$88.40 per month (16). Assuming that each worked a ten-hour day and there are twenty six working days in a month, the rate per hour for the day man was 61¢ and for the month man 34¢ or scarcely more than half. The length of working day is also an important factor in labor cost. As was pointed out in the discussion of labor rates, on two farms paying practically the same wages, the cost per hour of labor was twenty cents on the one where the working day averaged eight and one-half hours and only fourteen cents on the one with an eleven hour day. The farm with the high hour cost paid a slightly higher wage but the difference in the length of working day is responsible for most of the difference in hour costs. By so organizing the farm as to provide a uniform distribution of productive labor throughout the year and so directing this labor that it performs a full day's work each day, a considerable saving in labor cost is possible.

Table XXIII emphasizes the factors of economy in the cost of horse labor. The farms showing low horse labor costs expended much less on the care and upkeep of their horses than did those having the high costs. Feed economies are especially important. These Farms having the low horse labor rates were also so organized as to provide a much larger number of hours work per year for each horse



than the high labor rate farms, thus further lowering the rate per hours.

#### Land Charge & the Farm Organization.

The second major cost of wheat production, land charge, although subject to wide variations between different farms and different localities, offers little suggestions as to farm organization except in crop selection. The land charge on certain pieces of land may be so high as to make their use profitable only for intensively cultivated crops whose acre value is high. Otherwise variations in the land charge do not offer suggestions for improving the farm organization since the land charge is a relatively fixed charge.

#### Other Costs and the Farm Organization.

The variations in other costs offer some suggestions as to farm organization and operation. The optimum rate of seeding may be determined, but with wheat this is already fairly standardized in most communities within a comparatively narrow range. Twine, threshing cost, and crop risk or insurance are all costs that are largely fixed by factors outside the farmer's control. The manure cost is completely within the farmer's control but there is no data in the studies cited to indicate the bearing of manure cost on total costs or returns. Machinery cost varies largely with scale of production, the machinery being more efficiently used on the larger farms. (40). The overhead charge is determined largely by the efficiency of labor utilization on the farm and anything that will serve to cut down the amount of unproductive labor on a farm will decrease this item of cost.

#### Yield and the Farm Organization.

Yield, as has been shown by all the tables presenting this factor, is the most variable of all factors of wheat production costs. It is the most important factor in determining bushel cost. In the data presented a high yield usually results in a low cost per bushel and hence a profitable crop. This importance of yield as a factor in profit cannot be overestimated. In practically all the studies cited, production costs per acre increased with the yield but not fast enough to prevent a decreasing bushel cost. Just how far this process of increasing yields without increasing bushel costs can go, it is hard to say. Yield is affected by a large number of factors not under the farmer's control such as climate, disease, insects, soil types, topography, latitude, altitude, and a wide variety of physical agencies. With these he can do nothing in attempting to increase his yields. He must then turn his attention to those factors within his control.

In 1910 the late Dr. Cyril G. Hopkins addressed a questionnaire to the directors of the leading Agricultural Experiment Stations in the old world inquiring as to what in their opinion were the factors involved in increasing crop yields (13). Their replies indicate that these factors and their relative importance, at least as far as the old world is concerned, are

Fertilizer	50%
Better tillage	25%
Better seed	15%
Better crop rotation	10%

Undoubtedly all, or at least most, of these factors are also the important methods of increasing crop yields in America but their relative importance on our comparatively virgin soil varies from that of the old world soils that have been cultivated continuously for centuries. For instance, commercial fertilizers and even farm manure increase crop yields little if any on some of our Minnesota

soils. The soil fertility and management studies at the Agricultural Experiment Sub-Station at Crookston, Minnesota, showed that "because of the natural high fertility of the soil neither manure or commercial fertilizer has as yet shown much effect on crop yields, but such management of the soil as will free it from weeds and allow it to accumulate a liberal supply of moisture shows strikingly beneficial results" (50). In 1918 on account of the importance of increasing wheat production for war purposes, the Minnesota Agricultural Experiment Station and all the substations carried on extensive experiments with the use of phosphate fertilizers. At Morris a marked increase in wheat yields was obtained, but at University Farm, Grand Rapids, Duluth, and Crookston, there were only slight increases in yields, if any, and not sufficient on which to base definite conclusions in favor of phosphate fertilizers (50). At University Farm, "commercial fertilizers in the form of raw rock phosphate, acid phosphate, muriate of potash, and sodium nitrate, used singly and in combination, applied to oats and corn in a three-year rotation, oats, clover, corn, did not, for the six year period in any instance give consistent increases in yields of any consequence" (1). Apparently the use of commercial fertilizers is limited in its effect in increasing crop yields in Minnesota and the matter of fertilizers in general is not nearly so important as in the old world.

The value of better tillage has already been mentioned in the Crookston report. It is an important factor in increasing crop yields in Minnesota but better tillage means more man labor and more power and both are expensive items. Furthermore man labor is scarce as well as high in price and the farmer must use it judiciously.

Little can be done by the individual farmer in the way of

better seed except in carefully cleaning, grading, and treating for disease, the varieties he has. For the development of new varieties he must depend on his state agricultural experiment station and the United States Department of Agriculture.

Probably the factor last named and considered the least important by the European authorities, - better crop rotation, offers the most profitable possibility in increasing crop yields in Minnesota. The Minnesota Experiment Station has found that by the use of a four-year rotation of oats, wheat, clover, and corn, the wheat yield may be increased 30.98% over continuous wheat and the profit per acre increased 72.3%. (1). It would appear therefore that since yield is such an important factor in crop profits that the farmer should so organize his farm as to provide a good rotation, to select and prepare his seed carefully, and to prepare his seed bed thoroughly and apply fertilizers in so far as the added returns more than offset the added cost, and that he use every effort to increase his yields as a means of lowering production costs per unit of product.

#### COST VARIATIONS & PRICE FIXING.

Since the cost of production is so generally associated in the minds of many people with the idea of price-fixing and since attempts have been made to use it for such purpose it seems well to mention the bearing of cost variations on such use. Obviously there is no such thing as the cost of producing wheat. The amazing array of costs that have been presented naturally give rise to the question as to what cost or whose cost shall be used as a basis for price. Shall the price be fixed at the average cost or should we establish a "bulk line" cost? Prof. F.W. Taussig states the principle that if variations in cost are due to variations in the managerial



ability of different men, the average cost is the better basis but if such variations are due to causes in nature a "bulk line" cost covering the marginal producer should be established. (37). Since variations in wheat production costs are due to both sets of causes it is impossible to apply this principle in setting a price in this case. Whatever one may think of the justice or desirability of price fixing as a principle, they must conclude that these wide variations in costs between different farms, counties, and states, and between different years introduce serious if not insurmountable barriers to such practice.

#### SUMMARY AND CONCLUSIONS.

1. All cost studies reveal a wide range of costs for a given unit of production.

2. These variations in cost may be divided into two classes - "real variations" or those due to actual differences in the factors of cost involved, and "apparent variations", or those resulting from differences in methods of computing costs.

3. "Real variations" are due to two sets of causes: - differences in nature's response to man's efforts, and the differing managerial abilities of different men.

4. Uniformity in methods of cost study and cost computations would eliminate most of the "apparent" variations.

5. Cost account data are more valuable than survey or questionnaire data in analysing cost variations.

6. The average is a better type to use in presenting a range of costs than is the mode or median but the range or frequency table gives the most complete picture of such a range.

7. The acre is the most stable unit on which to base crop production costs and the most valuable in studying factor variations but the bushel basis is useful in studying the relation of cost to selling price.

8. There is no such thing as a cost or the cost of producing a bushel or an acre of wheat but rather a wide range of costs between different farms, different localities, and different years.

9. Certain farms are so situated and organized that they show high production costs consistently for a given product whereas other farms just as consistently show low costs; likewise a farm holds its rank with respect to the average quite consistently with each of the factors of cost.

10. Labor is the one factor of cost most completely under the farmer's control and variations in this item suggest possibilities of cutting costs by using labor more effectively.

11. The land charge, while a widely variable item of cost, is fairly fixed as far as the individual farm is concerned and is outside the farmer's control.

12. Variations in seed cost, twine cost, threshing cost, and insurance costs are caused largely by factors outside the farmer's control and offer little suggestion as to possible economies.

13. Manure costs and overhead costs are subject to the farmer's control and it is within his power to regulate variations in these items.

14. Yield is one of the most important factors in cost variations, especially in regard to bushel costs.

15. In general acre costs increase as yields increase but bushel costs decrease. Increased yields are an important factor

in increasing the returns from the wheat crop.

16. Long time averages are necessary as a basis for applying cost data to farm organization.

17. Large scale production serves to decrease production costs.

18. The wide variations in wheat production costs makes the cost of production a very imperfect if not an altogether impractical basis for price fixing.

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Table XXIV.

Variations in Labor Cost per Acre  
On Six Minnesota Farms, 1913-1917. (45).

(Cost Account Data).

Year	Farm No.1	Farm No.2	Farm No.3	Farm No.4	Farm No.5	Farm No.6	Av'g. All Farms
1913	\$4.14	\$4.31	\$	\$3.64	\$-2.48	\$	\$3.64
1914	-2.23	+4.33	-2.32	+3.89	-3.20	+4.53	3.42
1915		+5.21	-3.55	+4.64	-3.46	-3.53	4.08
1916		+5.80		+4.63	-2.72	-3.62	4.19
1917		+6.57	-4.58	-4.81	+5.40	-3.88	5.05
Av'g.	-3.19	+5.24	-3.48	+4.32	-3.45	-3.89	3.93

The results given in Tables XIX, XX, XXI, and XXII, are summarized in Table XXIV. The fact that certain farms are characteristically and uniformly high labor cost farms is strongly emphasized here. The fact is brought out much more clearly than in the other tables. Although there is a considerable variation from year to year on any one farm, that farm holds its relative position with regards to the average very consistently. It is further interesting to note that high or low labor costs are not characteristic of any given community or locality. Farms 2 and 3 are in the same community yet the costs on Farm 2 are high each year and on Farm 3, low. Likewise Farms 4, 5, and 6 are in the same community, yet Farm 4 is uniformly above the average in labor cost per acre and Farms 5 and 6 are below. Apparently the plan of organization, the system of operation, and the equipment of the individual farm have more to do with labor economics than do location or soil type.

Variations in Land Charges.

Range in Land Charge Variations. The second item of cost in wheat