# THE EFFECT OF UNDERGROUND WATER SUPPLY ON LAND VALUES IN SOUTHWESTERN KANSAS

by

SAMUEL HECTOR LEE

B. A., Fort Lewis College, 1966

---

A MASTER'S THESIS

Submitted in partial fulfillment of the

requirements for the degree

MASTER OF ARTS

Department of Economics

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1968

Approved by:

Major Professor

ACKNOWLEDGMENTS

The author would like to express sincere thanks to Dr. Edgar S. Bagley, Professor of Economics and major professor, for the direction given in this study. Thanks are also due to Dr. Wilfred H. Pine, Department of Economics, for his many helpful suggestions.

The author would also like to thank all the landowners in the four county area of Grant, Stanton, Morton, and Stevens Counties who were good enough to fill out and return the questionnaires which provided the data for much of this analysis.

TABLE OF CONTENTS

LIST OF TABLES

## LIST OF FIGURES

# INTRODUCTION

Underground water is water that has seeped down into the earth's porous upper layers. Beneath the porous upper layers of the surface of the earth are impervious layers of rock, shale, or clay, below which water cannot be found. There is very little fresh water below 3,000 feet, it is rarely found as deep as 10,000 feet, and it is completely absent at 20,000 feet or more. As the ground has become saturated over millions of years, the water table has generally risen, but in most places it fluctuates with changes in the amount of rainfall. The geologic formations of the earth are non-homologous, causing variations in the locations and types of water deposits. Thus, water is found in swamps, artesian wells, seeps, springs, geysers, and all combinations of underground phenomena. Some of the oases in the Sahara Desert receive their water from sources hundreds of miles away, in the African mountains. Some of the ground water found in western Nebraska has its source in the Colorado Rockies.[1] It is popularly believed in western Kansas that the ground water in that area comes from the Rockies,[2] too, but such is not the case.[3]

---

[1] For a more detailed discussion, see "Geology, Underground Water," World Book Encyclopedia, (Chicago: Field Enterprises Educational Corp., 1965), Vol. 8, p. 102.

[2] Robert Bennett Kerchner, "The Knowledge of and Attitudes Toward Kansas Water Rights Law of Irrigators In the High Plains of Western Kansas," (Unpublished Master's report, Department of Economics and Sociology, Kansas State University of Agriculture and Applied Science, 1960), p. 37.

[3] Kansas Water Resources Board, State Water Plan Studies, Part A, Preliminary Appraisal of Kansas Water Problems, Section 2, Cimmarron Unit, September, 1958, p. 47.

In many areas, water has been stored in subterranean deposits for tens of thousands of years without measurable effect on land valuations because its presence was not known to the landowner, or because it was not technologically feasible to use it, or because the land itself was not being used. In recent years, however, there has been large-scale withdrawal of ground water, especially for agricultural purposes, which has resulted in a considerable increase in land values. The reasons for the change are; first, new, low-cost methods of well-drilling make it possible for the small farmer to afford to drill test holes on his own farm, second, technological developments in pumping have made it possible to lift water from deep wells at a low cost, third, technological developments in irrigation, principally sprinkler systems, have made it economically feasible to irrigate lands formerly regarded as non-irrigable because of sandy soil or sloping terrain, and fourth, low-cost power units and fuels make it possible to pump water at a cost that will yield a profit. Southwestern Kansas is an area where irrigation from ground water has greatly expanded in recent years.

The specific problem considered in this paper is: What is the effect of underground water on land prices in southwestern Kansas?

The presence of water on the surface has a definite effect on land productivity and on land value. If there is too much water, the land is swampy and the value is low. If there is not enough, the land is desert and the value is low. The correct amount of water, whether obtained through rainfall or irrigation, results in

higher productivity, and consequently, higher land values.

Certain areas in the United States, such as the Texas High Plains, parts of Arizona, or the Central Valley of California, have experienced significant changes in land values after the successful application of ground water to irrigable farm land.[4] It is reasonable to suppose that the same would be true, as ground water is developed for irrigation, in southwestern Kansas. The question of "How much?" is the purpose of this study.

The problem of measurement becomes rather complicated, because land values are affected by many variables. The real estate market is an imperfect market, since land is non-homogeneous and subject to infrequent market transactions.[5] Both monopolistic and monopsonistic approaches to sale price are frequently made by sellers and buyers, respectively. These, and other factors, make the appraisal process a difficult and complex job. The various factors that influence a determination of price, and the difference between price and value, will be discussed in more detail later. Suffice it to say, at this time, that this study is concerned with the price of water, and is approached via the avenue of actual market prices paid for land underlain by ground water, not the value of the changed income potential of land with water.

---

[4] Edgar S. Bagley, "Ground Water Depletion Under Federal Income Tax Law," The Kansas Agricultural Situation, (Manhattan, Kansas: Kansas State University, May, 1966), p. 6.

[5] Wilfred H. Pine and William H. Scofield, The Farm Real Estate Market in Kansas, (Manhattan, Kansas: Kansas Agricultural Experiment Station, Kansas State University, January, 1961), p. 5.

## SIGNIFICANCE OF THE STUDY

As is true with any new development in use of productive factors, by which their marginal productivity is increased, so it is true that development of irrigation with ground water has resulted in a higher value for such lands. The higher value of irrigable farm acres is of considerable interest to landowners, prospective buyers, property tax assessors, real estate brokers, professional appraisers, and investors.

Landowners are the recipients of windfall gains if they acquired the land prior to the new development. They may realize their gains by selling the property, or by developing the water themselves. A knowledge of the changes in value of their holdings can be helpful in deciding how to capitalize on these developments.

If landowners have recently acquired the lands in hopes of developing water, the breakdown of the actual purchase price to show how much was paid for water and how much for the land may possibly be useful in establishing a claim for cost depletion for federal income tax purposes.[6]

Prospective buyers could use the valuation of water and land in their computations of optimal use of the resources, as well as the computation of the purchase price they can justify paying.

Property tax assessors, real estate brokers, and professional

---

[6] Bagley, p. 6. An Internal Revenue Service ruling that cost depletion will be allowed to taxpayers in the Texas High Plains may possibly be expanded to include other areas, if the following requirements are met: (1) there must have been a cost for the water, or there is no investment to be recovered, (2) the ground water must be depletable, that is, the source must be non-rechargeable, and (3) the rate of depletion must be ascertainable.

appraisers would find the information useful in the performance of their vocational functions.

## REVIEW OF LITERATURE

The huge volume of literature that has been written about appraisal and valuation of real estate is more than can be covered in this thesis. However, there is one eminent work, which stands above all others as an authority in the field of appraising, and that is James C. Bonbright's Valuation of Property.[7] It has been the principal authoritative work in its field for many years. It covers all phases of real estate appraisal, and it contains some good chapters on the three conventional methods of property valuation: the replacement cost approach, the income approach, and the market comparison approach.

The point of view taken by Bonbright is, of course, the valuation of property from the legal aspects of the problem. There is much to be learned by economists from the legal profession, so this work is good background for a study in land valuation.

The American Institute of Real Estate Appraisers has published a book, Appraisal Terminology and Handbook,[8] that should also be mentioned. It is a complete handbook for use as a guide, a cook-book approach, to appraisal procedures for all types of property, including residential, industrial, business, and agricultural. Also worthy of mention among books of this type are the works by

---

[7] James C. Bonbright, The Valuation Of Property, 2 volumes, (Charlottesville, Virginia: The Michie Company, Law Publishers, 1965 reprint).

[8] American Institute of Real Estate Appraisers, Appraisal Terminology and Handbook, (New York: 1954).

Edith Friedman[9] and Alfred Ring,[10] which cover about the same subject matter as the first two.

Even though there is an abundance of literature on the general field of land valuation, there is remarkably little which deals with the particular problem of the effect of ground water on land values. However, there have been several studies completed on the effect of other factors on farm real estate values. The methodology used in some of these has been very helpful in the pursuit of this study.

Particular mention should be made of the bulletin, Effects of Roads and Other Factors on Farm Real Estate Values in Kansas.[11] The authors point out that a "single factor analysis . . . is likely to produce biased estimates of the effects of the single factor on land prices. A multiple factor analysis is, therefore, advisable."[12] However, this paper is an attempt to isolate one factor for analysis and to account for the other factors by comparing the farms on a one-to-one matched-pair basis, keeping as many factors similar between farms as possible, except the isolated factor of underground water.

---

[9] Edith J. Friedman, ed., Encyclopedia of Real Estate Appraising, (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1959).

[10] Alfred A. Ring, The Valuation of Real Estate, (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1963).

[11] Jack D. Edwards, Wilfred H. Pine, and Arlin M. Feyerherm, Effects of Roads and Other Factors on Farm Real Estate Values in Kansas, Bulletin 469, (Manhattan, Kansas: Agricultural Experiment Station, Kansas State University of Agriculture and Applied Science, October, 1964).

[12] Ibid., p. 3.

There is a certain amount of subjectivity in all land valuations, as is pointed out by Edwards, "Market prices may not provide a true measure of real value . . ."[13] due to such things as imperfect knowledge of buyers and sellers, infrequency of transaction, etc. More will be said on this in the next section.

Edward's multiple regression study showed a coefficient for irrigated acres of $29.00 per acre in southwestern Kansas, with a coefficient of determination of $R^2 = .6950$, significant at the 1% level, for the period 1956 - 58. The present study indicates that a higher coefficient would be obtained for the period of 1962 - 65. Part of the difference between the $29.00 indicated by Edward's study and the $93.00 indicated by this study may be due to the type of coefficient desired. Edward's study was used to determine the additional value of an entire farm due to a variable number of irrigated acres, while this study isolates the coefficient of value for the presence of underground water. Also, much of the difference is due to the difference in time period studied.

Another study, Trends in Land Values in Kansas,[14] computed trends in land values by region and by type of farming area for twelve areas of the state. For the area which includes the four counties discussed in this study, value per acre of farm land rose from approximately $40.00 per acre in the early 1940's to over $150.00 per acre in 1959.[15]

---

[13] Ibid., p. 14.

[14] Harold H. Ramsbacher, Wilfred H. Pine, Merton L. Otto, and J. E. Pallesen, Trends in Land Values in Kansas, (Manhattan, Kansas: Kansas State University, May, 1960).

[15] Ibid., p. 16.

Weighted averages for several categories of farm tracts were used in a study, The Value of Farm Real Estate,[16] but no conclusive results were given, and nothing was mentioned pertaining to water values.

An unpublished work by Richard U. Ratcliff, G. Graham Waite, and Dean T. Massey,[17] appears to be a good treatise on the market simulation of land values for purposes of condemnation or taking, or for real estate valuation and appraisal in general, but no attention is specifically given to the presence or absence of underground water.

The Farm Real Estate Market In Kansas is an interesting analysis of the nature and characteristics of this state's farm real estate market, but again, nothing is specifically mentioned concerning the determination of water value.[18]

A dissertation by David M. Nelson[19] is concerned with the value of water for irrigation in the Kansas River Valley to determine efficiency in use for allocating water among competing uses to maximize social benefits. Such efficiency is attained when

---

[16] Charles F. Marsh and Wilfred H. Pine, The Value of Farm Real Estate, A Study of Sales in Brown and Saline Counties, Kansas, (Manhattan, Kansas: Agricultural Experiment Station, Kansas State University, April, 1957).

[17] Richard U. Ratcliff, G. Graham Waite, and Dean T. Massey, "Rules of Compensability, Valuation and Evidence in Highway Land Acquisition," (Unpublished study by University of Wisconsin, September, 1967), pp. 112-163.

[18] Pine and Schofield, p. 5.

[19] David Michael Nelson, "The Value of Water for Irrigation in the Kansas River Valley," (An unpublished doctoral dissertation, Kansas State University, 1968).

marginal value product equals marginal unit cost for all uses to which the resource is put. Data were obtained by a survey of irrigators. The method of valuation of water was the income approach, using production functions and deducting costs of obtaining water, to compute a net return to the farmer, or other water users, from water. The net return from 1951 to 1965 showed a net loss of $25.28 per irrigated acre of corn, but was positive for other crops, such as fruits and vegetables.

## METHOD AND APPROACH

### Definition of Terms

Justice Brandeis said, "Value is a word of many meanings." The truth of this statement is evidenced by the fact that The Encyclopedia of Real Estate Appraising lists seventy-six different definitions of various types of value. One term used in this paper, the connotation of which should be definite, is market value.

The following definition is given by the American Institute of Real Estate Appraisers:

"1. The price at which a willing seller would sell and a willing buyer would buy, neither being under abnormal pressure.

"2. The price expectable if a reasonable time is allowed to find a purchaser and if both seller and prospective buyer are fully informed."[20]

A more comprehensive definition is given as follows:

"Market value is the price which a willing buyer would be justified in paying and a willing seller would be warranted in accepting, if each is (1) well-informed or well-advised, (2) motivated by reactions of typical users, (3) free of undue stimulus, (4) financially capable of ownership, occupancy, and/or use, and (5) allowed a reasonable time in which to test the market."[21]

Market value is not always the same thing as market price.

---

[20] American Institute of Real Estate Appraisers, p. 163.

[21] Friedman, p. 20.

The price of a good may be either above or below its value. While the word value is very nebulous and hard to define, price is very straightforward, concrete, and exact. Actual market transactions are consummated at prices that are sometimes above, sometimes below market value. By taking an average of several actual sales prices, a more nearly accurate estimate of market value can be obtained.

Under conditions of perfect competition, market price equilibrates market value. However, under conditions of imperfect competition, specific market prices may fluctuate above or below market value, and are dependent upon many subjective factors relating to circumstances and conditions of the particular transactions involved. This study uses an average of market prices to try to arrive at an estimate of market value. The distinction between value and price made by Webster's Dictionary is apropos, "the quantity of money, goods, or services, which an article is likely to command in the long run, as distinct from its price in an individual instance."

The term "mineral rights" will be used in this paper to include both sub-surface oil and gas rights and sub-surface mineral rights.

The term "water rights" will be used in the same sense that it is used in The Kansas Appropriation Act of 1945 as amended June 29, 1957. That is, "All water within the State of Kansas is . . . dedicated to the use of the people of the state," but rights may be established by a certain procedure and protected for private use, based on the appropriation concept of a water right with prior

claims establishing priority.[22] The statute provides that, "If a proposed useneither will impair a use under an existing water right nor prejudicially and unreasonably affect the public interest, the chief engineer shall approve all application for such use made in good faith and in proper form, which contemplate the utilization of water for beneficial purposes within reasonable limitations."[23]

The term "generally unsuitable for irrigation" will be taken to include lands where topsoils have been washed away and where land is not level, that is, 5% slope or more.

### Selection of the Area

The four county area consisting of Grant, Stanton, Morton, and Stevens counties was chosen for this study because, there, the irrigation of land, using underground water, is well-developed and widely practiced. Some of the first irrigation wells in the state were in the Grant-Stanton area. The water is plentiful and adapted to irrigation. There are, within the area, farm tracts that do not have water under them, making possible the comparison of dry and irrigated farms. A smaller area would not have yielded a large enough sample, while a larger area would have resulted in greater dissimilarity between farms.

---

[22] Kansas General Statutes, 1949, Sec. 82a-702; cited by Wells A. Hutchins, The Kansas Law of Water Rights, (Topeka, Kansas: 1957), p. 28.

[23] Kansas General Statutes, 1949, Sec. 82a-711; cited by Hutchins, p. 31.

Irrigation has increased in these four counties from less than 60,000 acre-feet in 1950 to over 474,000 acre-feet in 1966,[24] all of which is from ground water. Recharge is estimated to be less than 36,000 acre-feet a year,[25] so the net difference is "mined."

Geology, Hydrology, and Climate. All four counties are in the High Plains section of the Great Plains province. Farming is the chief industry, with wheat and grain sorghums being the major crops. The climate is semi-arid, the average rainfall about fifteen inches along the western border, increasing slightly to about seventeen inches along the eastern border.[26] However, average figures can be misleading for the area because of the great variability from year to year and because many of the rains are localized and torrential. Over a period of the last fifty-two years, Hugoton recorded the maximum annual rainfall of 32.15 inches in 1946, while Johnson recorded a minimum of 4.77 inches in 1956.[27]

> Droughts have been the major problem in this Unit during its agricultural history. As early as the 1890's, irrigation projects were developed to supplement precipitation during dry periods. One was near Englewood in Clark County. It was soon discovered that the river would not supply sufficient water to meet the demands, and the project was abandoned. Attempts to utilize ground water from artesian wells were made near Richfield in Morton County during the 1890's, but the quality of the water was

---

[24] Estimate obtained from Extension Engineering, Kansas State University.

[25] Estimate obtained by using the ratio of area in the four county area to the whole Cimarron Unit and taking that percentage of the estimate given in State Water Plan Studies, p. 83.

[26] Kansas Water Resources Board, p. 35.

[27] Ibid.

poor and the project was later abandoned. Irrigation was practiced in the artesian valley of Meade County in the early 1900's from flowing artesian wells. Some pumping of the artesian wells occurred in 1909, but did not develop rapidly until after 1938.

The drilling of upland irrigation wells started in the 1930's, but many were abandoned because of the great lifts, soil conditions, or market conditions. Extensive pumping of ground water has developed primarily during recent years, especially during the 1951-56 drought. An important factor in this development has been the availability and use of natural gas as a fuel for the power units.[28]

Soil Types. The area covers approximately 3240 square miles. Except for a small area in eastern Grant County where the soil type is Keith, Colby, the area is predominantly Dalhart, Richfield, Mansker and Richfield, Colby soils. The Keith, Colby is "grayish brown and dark grayish brown silt loam. These soils occur on undulating to nearly level relief. They are well adapted to the production of wheat and sorghum. Sorghum chlorosis may be expected to occur on the sloping Colby soil, which occurs near the drainage ways. Keith is an excellent soil for irrigation."[29]

Dalhart, Richfield, Mansker soils are "brown and grayish brown fine sandy loams (Dalhart), silt loams (Richfield), and clay loam (Mansker) soils. These soils occur on nearly level to undulating relief. This is dominantly a sandy land area best adapted to native grass, but sorghum and wheat may be grown on the better areas."[30]

The Richfield, Colby soils are very similar to the Dalhart,

---

[28] Ibid., p. 27.

[29] O. W. Bidwell, Major Soils of Kansas, Topeka, Kansas: Kansas Agricultural Experiment Station, July, 1956), p. 11.

[30] Ibid., p. 12.

Richfield, Mansker soils, but receive less moisture. As will be explained later, more detailed soil maps were used in this study.

Water Bearing Strata. The whole area is underlain chiefly by the Ogallala formation. This is the principal water bearing formation, which yields moderate to large quantities of water. The maps in Figures 1 and 2 show the depth to water and the thickness of the water bearing strata. The depth to water varies from near zero to over 200 feet below the surface. The thickness of the water bearing Ogallala formation, in both the Pliocene and Pleistocene deposits, varies from zero to several hundred feet.

The four county area included in this study includes land with water, land without water, land suitable to irrigation, land not suitable to irrigation, and combinations of land suitable for irrigation under which there is an abundance of water, and combinations of land suitable for irrigation under which there is no water. Figure 3 shows the lands suitable for irrigation. A large portion of the south half of Stevens County is sand dune surface topography, and unsuitable for irrigation even though there is apparently plenty of water.

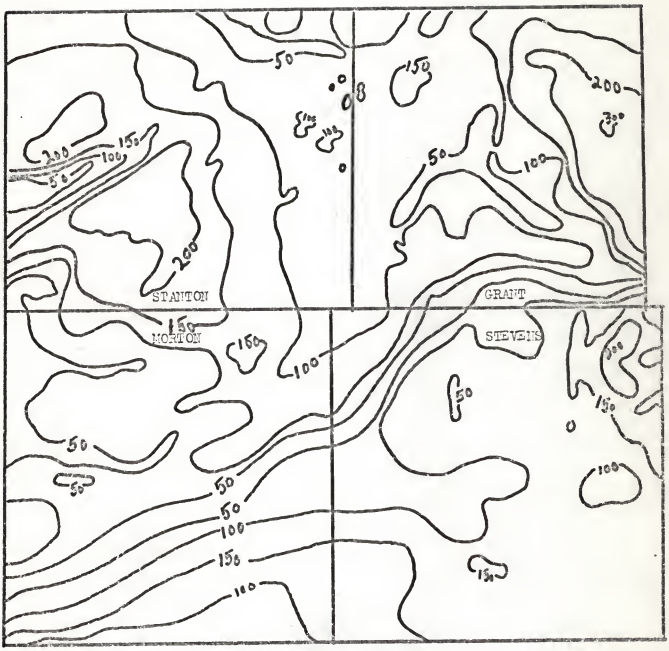


Figure 1. Contour map showing depth to water in Grant, Stanton, Morton, and Stevens Counties, State of Kansas. This map was furnished by the Kansas Water Resources Board, dated August, 1967.

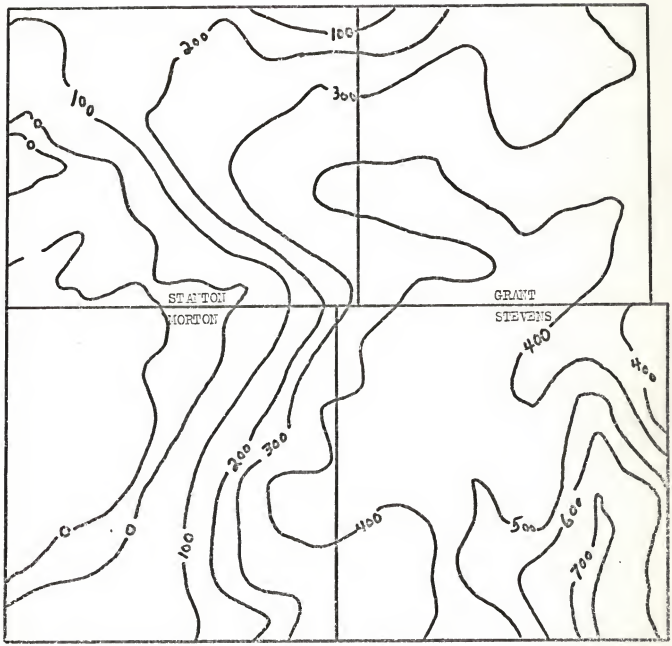


Figure 2. Contour map showing saturated thickness of water bearing strata in Grant, Stanton, Morton, and Stevens Counties, State of Kansas. This map was furnished by the Kansas Water Resources Board, dated August, 1967.

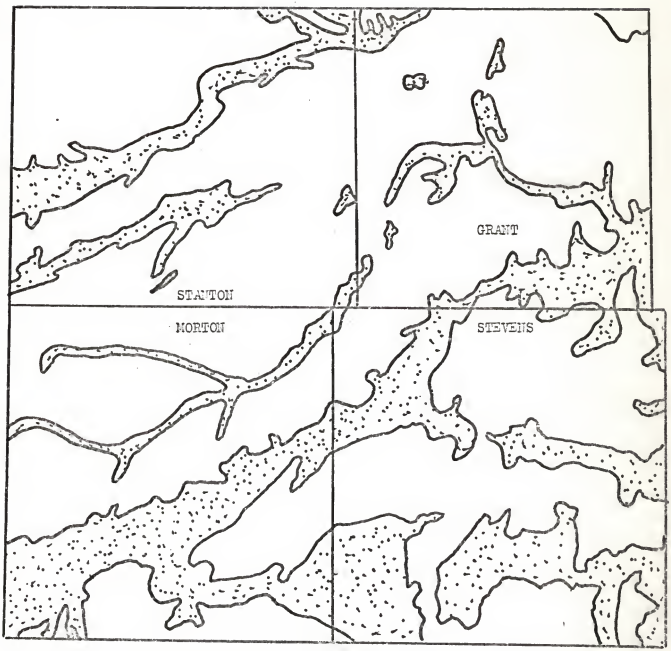


Figure 3. Map of Grant, Stanton, Morton, and Stevens Counties showing land not suitable for irrigation. Shaded areas are not irrigable.[31] Inasmuch as this map was drawn before the innovation of sprinkler irrigation, there is some land in the non-irrigable areas which could now be considered irrigable. This is the case with only one farm, 2W, in this study.

Legend: Generally unsuitable to irrigation.

Generally suitable to irrigation.

[31] State Water Plan Studies, p. 54.

### Selection of the Time Period

According to a study of trends in land values in Kansas, the value per acre of farm land in the southwestern corner of the state rose over 150% from the base period, 1947-49, to the end of 1959.[32] The fact that there is an apparent trend upward persuaded the use of a relatively short period of time, namely five years, for the data for this study.

The most recent sales data would be the most desirable for purposes of this analysis, but the number of cases within the past one year would yield such a small sample as to be statistically unacceptable. It was concluded that a five-year period would produce a large enough sample, hence, sales data includes market transactions from 1962 through August, 1967, at which time the field work was completed.

### The Basic Approaches to Real Estate Valuation

There are three conventional approaches to the problem of land valuation; the income approach, the replacement cost approach, and the market value approach. There is also the market simulation approach, a relatively new idea in the field of appraising.

The income approach is based on the anticipated income that will be derived from the property, less the costs of producing that income. The expected net income is then capitalized, or converted to a figure reflecting estimated worth in terms of present value.

---

[32] Ramsbacher, p. 16.

The accuracy of this method is dependent upon the accuracy of the prediction of expected income and costs, and the correctness of the estimate of the interest rate used to convert future income to present value.

The replacement cost approach as a determination of value is based on the expenditure, or cost, required to replace the property. Because land, itself, is immobile, and therefore not practically replaceable, this method is not very useful in the appraisal of land. Many land economics texts and appraisers overlook this method entirely.

The market value approach is based on a comparison of sales of similar property. A commonly accepted rule in appraisal practice is that four comparable sales are sufficient to serve as an appraisal base.[33] For example, when a farmer thinks about selling or buying land, he inquires about actual sales prices of similar places in the neighborhood. He feels more confident in setting his price, either as an offer to buy or as an offer to sell, if he knows he is somewhere near his neighbor's figure.

The value of a common stock, listed on the New York Stock Exchange, traded in volume every day, a perfectly homogeneous commodity, is readily ascertainable. Contrariwise, land may be transferred in market transactions only a few times a year, and each piece is different in some respects from any other. The true market value of land, then, is ascertained only with difficulty,

---

[33] Friedman, p. 101.

though a price is given for each transaction.

> The market simulation approach can be explained as follows. Simulation is a convenient, though perhaps unfamiliar, term to describe what most appraisers actually do in estimating value. The appraiser seeks to forecast the most probable transaction which may be expected to take place with respect to the subject property. Out of his observations of past market behavior he pulls together all relevant knowledge about how people have reacted in the market to this kind of property under these kinds of market conditions. He takes into account -- simulates -- all of the conditions which he thinks will effect this hypothetical situation . . . and then his "judgment" tells him that the property will sell for about $22,600.00."[34]

Ratcliff, Waite, and Massey then describe how model building can facilitate the process of simulation by considering the institutional setting, the legal content, dynamic and static productive factors, market reactions, and conditions of sale, to arrive at a more accurate appraisal of value. Instead of giving one particular figure for the value of a property, they give a probability qualification that the value falls within some given bounds, say 95% probability that it is between $26,000.00 and $29,000.00.[35]

This method is a "more complete, orderly, and directed approach to value,"[36] because it accounts for much more detail in itemizing the factors that determine market values, employs greater reality in its assumptions. It gives a forecast of the outcome of a hypothetical situation that, under normal conditions, commands more confidence.

---

34 Ratcliff, Waite, and Massey, p. 150.

35 Ibid., pp. 157-9.

36 Ibid., p. 164.

For this study, however, the market comparison approach will be used. This study is not concerned with hypothetical forecasts, but rather with actual market transactions that have already occurred. The results of the market comparison approach will be more useful in this particular study. The reasons for this are discussed in the next section.

Selection of the Market Comparison Approach

Of the four methods of valuation, the market sales approach was chosen for this study, primarily for the following reason. The actual market data embodies the actual prices paid by farmers, and therefore, includes the quantification of the value of water in every transaction where water was known to be present.

The task of separating this amount could be done by either of two methods; a comparison of transactions alike in as many respects, other than water, as possible, or by regression analysis. The method of comparison of like units was chosen over regression analysis mainly because a precedent had been established in Federal Courts, by which the value of water was established for income tax purposes in the Marvin Shurbet case.

It was first thought that it would be possible to use the amount of revenue stamps on each recorded deed as a basis of value, but because this proved to be unreliable, a slightly less accessible means was used. This will be explained later, under the discussion of the questionnaire and survey.

## Factors That Affect Real Estate Values

Many factors affect the market price agreed to by both parties in a land transaction. Here is a fairly comprehensive list of them.[37]

1. Size of tract.
2. Value of buildings and other improvements.
3. Quality of land; that is, soil and topography.
4. Water supply.
5. Proximity to market.
6. Proximity to urban area.
7. Climate.
8. Units of capital applied to the tract.
9. Quality of management.
10. Desirability as a home unit.
11. Assessed valuation and property taxes.
12. Productivity.
13. Acreage allotments and soil bank participation.
14. Capital gains income tax considerations.
15. Non-farm use; highway rights of way, easements, etc.
16. Knowledge of buyer and seller of other investment opportunities.
17. Ability to bargain.
18. Financial conditions of buyer and seller.

---

[37] Many of these are listed in previously cited works, such as Edwards, Pine, and Feyerherm; Marsh and Pine; Friedman; or Bonbright; Ratcliff, Waite, and Massey.

19. Mineral rights.

20. Possible changes in value of money (index) over period of repayment of mortgage.

21. Buyer's ownership of other land in the same area.

22. Accessibility of paved highways.

23. Type of vegetation on the land; walnut trees, other timber, crops, etc.

24. Recreational use possibilities.

Item number four, above, can be further broken down into factors that influence the market value of water.

1. Average acre feet of water deliveries per season.

2. The effect of seasonal water deliveries on the water table.

3. Legal ties between water and land.

4. Qualities of water.

5. Stock, or the total supply available, if geologically determinate.

6. Flow, or the rate of recharge, if determinate.

This study is an attempt to find a residual market value, based on actual real estate transaction, for underground water. By comparing the farms with water, that are alike in other respects, to those without water, a breakdown of the price between water and land can be established.

All transactions involving any of the following have been eliminated from the original data.

1. Tract less than forty acres.

2. The buyer and seller are related. (Unless there is some

indication that a fair market price was paid.)[38]

3. Actual sales price cannot be determined.

4. There is indication that the sales price was not the result of open market forces.

5. Purchase was for other than agricultural use.

---

[38] Ibid., p. 5.

## COLLECTING THE DATA

### Pre-planning For Exploratory Field Trip

It was hoped that sale prices could be ascertained by reference to the amount of revenue stamps on the recorded deed. However, Mrs. Beck, the Riley County Register of Deeds, said that before July 1, 1967, the amount of revenue stamps as an indication of sales prices was not reliable. After that date, Senate Bill Number 438, enacted by the Kansas legislature, requires that a Certicate of Value be filed by the grantee before the deed can be recorded.

A comparison of the actual amount of revenue stamps on the deed with the amount that should have been affixed, the latter being determined by finding the sale price as reported in the questionnaire, on Table 1 and reading the required amount, showed the following. Of the 117 replies, only 89 were close enough to be considered approximately accurate. This would immediately introduce an error in the sample data of approximately 24%, and was, therefore, not acceptable.

Though the market value could not be obtained from the deed, there was other information that could be, such as, names and addresses of buyers and sellers, dates of sale, amounts of revenue stamps, and legal descriptions of the property involved.

A data sheet was designed for the collection of pertinent information. (See Appendix I.) A supply of these was reproduced for use on the exploratory trip to the Grant County area. The

breakdown of sale price was not available through public records, and in most cases, even the total sale price was not given. Because of this, it was necessary to find another way to get the desired information.

## Field Trips

The field trips netted some useful information, as will be discussed in this section.

The deed register index listed all deeds in alphabetical, chronological order for each county. One data sheet was filled out for each piece of farm land over forty acres, except those that stated that there was a close relationship between the families of the buyer and seller. Most of the deeds in this category had no revenue stamps and a statement similar to this: "In consideration of One dollar and LOVE and AFFECTION . . ."

After two days of personal interviews with farmers who had purchased land, it was apparent that a mail survey by questionnaire would be more practical in terms of the ratio between time spent and information gained.

The Register of Deeds offices in Grant, Stanton, Morton, and Stevens Counties showed information in the deed record books that threehundred and twenty-five farms had changed hands between 1962 and August, 1967. (I should note that there were more than this, but some were eliminated from this study for reasons mentioned earlier. Also, there were a few in Stevens County that were not listed because the office closed for the week-end before the list

TABLE 1.

COMPUTATION OF "PURCHASE PRICE DETERMINED BY STAMPS" FROM "AMOUNT REVENUE STAMPS ON DEED"

| Amount of Stamps | Purchase Price | Amount of Stamps | Purchase Price | Amount of Stamps | Purchase Price |
|---|---|---|---|---|---|
| $ .55 | $ 250 | $ 14.30 | $12,750 | $ 28.05 | $25,250 |
| 1.10 | 750 | 14.85 | 13,250 | 28.60 | 25,750 |
| 1.65 | 1,250 | 15.40 | 13,750 | 29.15 | 26,250 |
| 2.20 | 1,750 | 15.95 | 14,250 | 29.70 | 26,750 |
| 2.75 | 2,250 | 16.50 | 14,750 | 30.25 | 27,250 |
| 3.30 | 2,750 | 17.05 | 15,250 | 30.80 | 27,750 |
| 3.85 | 3,250 | 17.60 | 15,750 | 31.35 | 28,250 |
| 4.40 | 3,750 | 18.15 | 16,250 | 31.90 | 28,750 |
| 4.95 | 4,250 | 18.70 | 16,750 | 32.45 | 29,250 |
| 5.50 | 4,750 | 19.25 | 17,250 | 33.00 | 29,750 |
| 6.05 | 5,250 | 19.80 | 17,750 | 33.55 | 30,250 |
| 6.60 | 5,750 | 20.35 | 18,250 | 34.10 | 30,750 |
| 7.15 | 6,250 | 20.90 | 18,750 | 34.65 | 31,250 |
| 7.70 | 6,750 | 21.45 | 19,250 | 35.20 | 31,750 |
| 8.25 | 7,250 | 22.00 | 19,750 | 35.75 | 32,250 |
| 8.80 | 7,750 | 22.55 | 20,250 | 36.30 | 32,750 |
| 9.35 | 8,250 | 23.10 | 20,750 | 36.85 | 33,250 |
| 9.90 | 8,750 | 23.65 | 21,250 | 37.40 | 33,750 |
| 10.45 | 9,250 | 24.20 | 21,750 | 37.95 | 34,250 |
| 11.00 | 9,750 | 24.75 | 22,250 | 38.50 | 34,750 |
| 11.55 | 10,250 | 25.30 | 22,750 | 39.05 | 35,250 |
| 12.10 | 10,750 | 25.85 | 23,250 | 39.60 | 35,750 |
| 12.65 | 11,250 | 26.40 | 23,750 | 40.15 | 36,250 |
| 13.20 | 11,750 | 26.95 | 24,250 | 40.70 | 36,750 |
| 13.75 | 12,250 | 27.50 | 24,750 | 41.25 | 37,250 |

NOTE: The above table applies to all transactions from July, 1940, to date, the federal tax for that period being 55¢ on $100 to $500, and on each additional $500 or fraction thereof. This table has been adjusted to give a median purchase price of the range represented by the stamps. For example, $5.50 in stamps indicates a purchase price ranging from $4501 to $5000. Therefore, $4750 is selected as being the most accurate single figure for $5.50 stamps.

For determining purchase prices represented by stamps in excess of those listed on the table, divide the amount of stamps by 11, add two zeros (disregard decimal point) then deduct $250. For example, amount of stamps $41.50 divided by 11 = $380. Add two zeros to get $38,000. Deduct $250 to get $37,750.

was completed and the remaining number was too small to justify making a return trip.) After the lists were completed, addresses of owners were obtained from the various county assessor's offices.

### Questionnaire and Mail Survey

When the list of transactions was completed and addresses of purchasers obtained, a questionnaire was designed for mailing. (See Appendixes II and III.) There were three hundred and twenty-five letters of transmittal and questionnaires mailed out, with stamped, self-addressed return envelopes. Those were all sent during the week of August 28, 1967. Within two weeks, ninety-nine replies had been received. On September 15, two hundred and twenty-six post cards were sent to those who had not yet responded, reminding them of the questionnaire. This brought sixty-three more returns before the cut-off date of October 12, 1967, making a 49.85% success. Following is a breakdown of the replies which were received:

| | |
|---|---|
| Purchasers who claimed to know of the presence of ground water . . . . . | 54 |
| Purchasers who claimed not to know of the presence of ground water . . . . . | 63 |
| Replies eliminated from the data for various reasons . . . . . | 45 |
| Total . . . . . | 162. |

There were one hundred and sixty-three who did not answer.

## ANALYSIS OF THE DATA

### Preliminary

The returned questionnaires were checked for completeness and acceptability on grounds of the relationship of buyer and seller, indications of sales price not resulting from free market forces, and size of tract. They were then separated into two groups; those to be rejected and those to be used in the study.

Those that were to be used were further divided into two groups; those that answered "yes," and those that answered "no," to question number four, "Did you know of the presence of underground water when you made the purchase?"

The data was then entered in chronological order by date of sale on two recap sheets, listing date, description, price of improvements, mineral rights, total net price of land and ground water, size of tract, net amount paid per acre, topography, soil types, amount of revenue stamps on deed, distance to elevator, and acres of wheat allotment. Pertinent remarks were also listed in the remarks column. (See Appendixes IV and V.)

As it turned out, the breakdown into only two categories was not sufficient to make a distinction between landowners that thought they had water and did, those that didn't think they had water but actually did, those that thought they had water but actually did not, and those that did not think they had water and actually did not. This weakness was probably due to the fact that the questionnaire did not make provision for anything but a "yes" or a "no"

answer. The wording of item four on the survey form was such that the landowners did not know what to put down as their answer when their particular case was not clear-cut. A further breakdown than just "yes" or "no" would have been better. Subjectivity in this study would not have been as much a problem, if this change had been incorporated into the questionnaire.

### Selection of Eighteen Pairs of Farms

After trying, unsuccessfully, to make a more rigorous analysis using all of the data in Appendixes IV and V, it was decided to screen the "yes" group for tracts that, according to the information given on the questionnaire, definitely had water at the time of sale. There were eighteen of them. By matching the eighteen with water with another eighteen, which, in the opinion of the purchaser, did not have water, it was felt that a more useful analysis could be made. Of course, no one can positively say that there is no water until a test hole is actually drilled. There have been many cases where a person has thought there was no water, and he has been proven wrong when water was later discovered, and vice-versa. Moreover, a test hole can be drilled on one forty acre tract and be dry, and another hole on a neighboring forty acre tract will reveal an abundance of water. It can be positively stated, at any rate, that on the eighteen places without water, no water had been found up to the date of sale, and the transaction did not appear to be a speculation with the hope of developing water. (There is one exception to this last statement. A visit

to the Water Resources Office in Topeka revealed that the purchaser had a well on a nearby tract before he bought this one. There has since been no well drilled, however, and the farm is not yet being irrigated.)

The group of eighteen irrigated farms were, of course, already isolated from the rest of the tracts in the "yes"group, the problem being to find a group of eighteen dry farms from the "no" group, alike in as many other respects as possible, which could be paired off with the first group. In order to choose them objectively, the following procedure was used.

First, since the data in Appendix V was listed chronologically, only the tracts with date of sale within six months of the date of sale of the irrigated tracts were considered.

Next, those of the above were checked for similar soils and topography, by locating them on detailed soils maps published by the Soil Conservation Service. Then, of those which were similar, a check was made for similar mineral rights, wheat allotments, and distance to the nearest elevator. The size of tract was also checked, and kept as near the same as possible.

The number and kind of improvements were also kept as alike as possible, but in cases where there was no similarity, an adjustment to the per acre value was made by deducting from one transaction or the other, the price of the improvements as they had been listed by the purchaser on the questionnaire.

If other relevant information was available, as noted in the remarks column of Appendix V, it was taken into account in the

process of matching.

If any of the above mentioned characteristics were unreasonably different (in the opinion of the author) and no adjustment could be made to compensate for the difference, that particular tract was eliminated from the group being considered. However, in some cases all the possibilities were eliminated, and the comparison had to be made with the best available match. (Again in the opinion of the author.)

It is recognized that there is a possibility of subjectivity entering the analysis.

Tables 2 and 3 list the eighteen pairs of farms, showing comparisons of the various factors that have been taken into consideration.

The average price per acre for those with water was $171.00. The average price per acre for those without water, which were matched by the above described process in all other characteristics, to those with water, was $78.00. The difference, assumed to be a residual value for water, was $93.00.

However, the dispersion around the average is large. The standard deviation is $40.17. The wide dispersion suggests that other factors, perhaps relating to the abundance of water, might have an important bearing on the price of the land. On the other hand, the median, the mode, and the midrange are all between $89.50 and $114.00. The graph in Figure 4 shows the frequency distribution of the data.

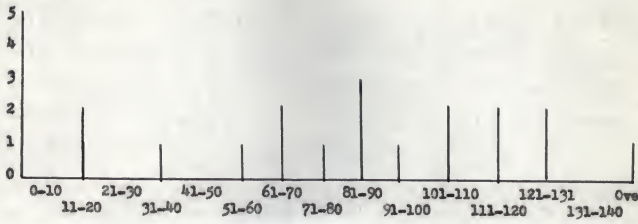


Figure 4. Frequency distribution of the net differences between per acre values of eighteen matched pairs of tracts without ground water and tracts with ground water.

Median = $89.50
Mode = 114.00
Mean = 86.94 *
Midrange = 97.00
Range = 156.00
Standard deviation = 40.17

* The mean of the differences is $86.94, while the difference of the means of the irrigated land and the dry land is $93.00. This is due to the fact that the latter is weighted by the number of acres in each farm. The $93.00 is probably a more meaningful figure.

TABLE 2. Eighteen Irrigated Farms

| Unit No. | Sale Date | Net Price | Tract Size | Price /Acre | Water GPM | Min. Rts. | Wheat Allot | Topo-graphy | Soil Types | Distance to Elev. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Oct 62 | $43000 | 240 | $179 | 1000 | Yes | 76 | 0-3% | Da,Db,Ub | 11 | |
| 2 | Nov 62 | 54000 | 320 | 169 | 2000 | No | 100 | 0-3 | Vx,Vo | 4 | Nat. gas, good land |
| 3 | Jun 63 | 52500 | 338 | 155 | 2500 | No | 105 | 0-3 | Ua,Ue, Rm | 8 | |
| 4 | Oct 63 | 16000 | 80 | 200 | 1200 | ⅓ | 30 | 0-2 | 36 | 9 | |
| 5 | Jan 64 | 18500 | 80 | 231 | 2000 | Yes | 20 | 0-2 | 54 | 3 | |
| 6 | Mar 64 | 24500 | 160 | 153 | 800 | No | 51 | 0-1 | Rm, Ua | 1 | Joined own land |
| 7 | Oct 64 | 55200 | 320 | 172 | | Yes | 100 | 0-1 | Rm | 12 | Test hole option |
| 8 | Oct 64 | 62000 | 320 | 194 | 1400 | No | 320 | 0-1 | Rm, Ua | 4 | Joined own land |
| 9 | Feb 65 | 84400 | 600 | 141 | 1600 | Yes | 198 | 0-3 | Rm, Ub | 4 | |
| 10 | Feb 65 | 61421 | 512 | 120 | 350 | Yes | 38 | 0-1 | Ua, Rm | 10 | |
| 11 | Nov 65 | 14000 | 80 | 175 | 900 | No | 27 | 0-2 | 54 | 11 | |
| 12 | Jan 66 | 24000 | 160 | 150 | 1500 | Yes | 57 | 0-1 | Ua, Rm | 15 | |
| 13 | Apr 66 | 110000 | 480 | 229 | 2400 | Yes | 155 | 0-1 | Rm,Ua | 2 | |
| 14 | Apr 66 | 24000 | 160 | 150 | 1500 | Yes | 51 | 0-1 | Rm,Ua | 11 | |
| 15 | May 66 | 88008 | 320 | 275 | 1500 | Yes | 101 | 0-3 | Rm,Ub | 2 | Joined own land |
| 16 | Jul 66 | 74200 | 640 | 116 | 200 | Yes | 160 | 0-1 | Rm | 1 | Developing irrig. |
| 17 | Aug 66 | 62000 | 320 | 194 | 1000 | Yes | 100 | 0-3 | Rm,Ua,Ub | 2 | |
| 18 | Apr 67 | 64700 | 320 | 202 | 1200 | Yes | 119 | 0-5 | Rm,Ub,Ua,Ox | 17 | |
| | Totals | 932429 | 5450 | 171 | | | | | | | |

TABLE 3. Eighteen Dry Farms

| Unit No. | Sale Date | Net Price | Tract Size | Price /Acre | Min. Rts. | Wheat Allot | Topo-graphy | Soil Types | Distance to Elev. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Oct 62 | $14400 | 160 | $ 90 | Yes | 47 | 0-1% | Ra,Ua,Ub | 9 | |
| 2 | May 62 | 7360 | 160 | 46 | No | -0- | | VQ,Vx | 5 | Public Auction |
| 3 | Mar 64 | 8300 | 160 | 52 | No | 56 | 0-3 | Ua, Ue | 20 | |
| 4 | Jun 63 | 16000 | 160 | 100 | ½ | 52 | 0-1 | Ra, Ua | 18 | |
| 5 | Feb 64 | 10000 | 80 | 125 | Yes | 42 | 0-1 | Ra, Db | 3.5 | |
| 6 | Jan 64 | 21400 | 160 | 134 | No | 53 | 0-1 | Ra, Ua | 2.5 | |
| 7 | Apr 64 | 27200 | 320 | 85 | ½ | 80 | 0-1 | Ua, Ub | 14 | |
| 8 | Jul 64 | 19500 | 160 | 122 | No | 80 | 0-3 | Da, Df | 4 | Joined own land |
| 9 | Oct 64 | 46000 | 640 | 72 | Yes | 221 | 0-1 | Ra, Ua | 12 | |
| 10 | Aug 65 | 32000 | 320 | 100 | Yes | -0- | 0-2 | 37 | 4.5 | |
| 11 | Dec 65 | 8800 | 80 | 110 | Yes | 28 | 0-2 | 54 | 10 | |
| 12 | Mar 65 | 9600 | 160 | 60 | Yes | -- | 0-3 | Ra,Ua,Ub, | -- | |
| 13 | Jan 65 | 18400 | 160 | 115 | Yes | 54 | 0-1 | Ra | 8 | |
| 14 | Feb 66 | 5867 | 53 | 111 | Yes | 13 | 0-1 | Ra, Ua | 17 | |
| 15 | Jun 66 | 16000 | 160 | 100 | Yes | 62 | 0-3 | Ra,Ub,Ue | 4 | Adj. for own land |
| 16 | Jul 65 | 93000 | 1600 | 58 | Yes | 329 | 0-3 | Ra,Ua,Ub | 22 | Sheriff's sale |
| 17 | May 67 | 12800 | 160 | 80 | Yes | 52 | 0-3 | Cb,Go | 20 | |
| 18 | Nov 66 | 12800 | 160 | 80 | Yes | 51 | 0-2 | 54 | 12 | Gov't survey showed no water |
| Totals | | 377792 | 4853 | 78 | | | | | | |

Comparisons On A One-to-One Basis

In pairing off the farms with water to those without water, the total number of acres in the unit were kept as near the same as possible, and the date of sale was kept, in most cases, within approximately six months of each other. The points of similarity and difference are shown in Tables 2 and 3. Some further comments follow. Unless otherwise stated, the values used in the following comments have been taken from the questionnaires.

1-1W. Both of these sales were in October of 1962 and both included mineral rights. The questionnaire showed that 1W included $12,000.00 for improvements (mostly well equipment) which was deducted before computing the per acre price of the land. The wheat allotment is approximately two percent difference, which is insignificant. The farms are almost the same distance from the storage elevator. Topographic variation is less than three percent in both cases. The soils on the irrigated land are Dalhart and Ulysses, both sandy loams, are only slightly inferior to the Richfield, Ulysses, silt loams of the dry farm. For wheat farming, the soils could be considered the same.

2-2W. The comparison here is very difficult because the land with water was known to have a good supply of water, known to be flat land, and known to have a very important extra, namely, natural gas which could be used for fuel to power the pumps, making it possible to keep the variable costs of irrigation very low. The value, given on the questionnaire, of the wheat allotment for the irrigated farm ($4,000.00) was deducted because there was no

allotment at all on the dry land. Also, the mineral rights, of $12,000.00 declared value, had to be deducted before a per acre comparison could be made. (The $12,000.00 figure was given by the landowner.) The farms are less than six months apart as far as the date of sale is concerned. They are in bordering sections, only a few miles apart, and the soils and topography are the same. They are four and five miles from the nearest elevator, respectively. The dry farm is 160 acres, while the irrigated farm is 320 acres. It should be mentioned that this sandy type of land, (Vona loamy and Vona Tivoli) is not good for crops unless there is an abundance of water. Even so, these two places make a good comparison for this study.

3-3W. The date of sale of the dry farm was about nine months after the irrigated one, and the acreage was less than half, but there were no other farms in the raw data that better suited the comparison than this one. The soils are the same, there are no mineral rights with the dry farm, but the one-quarter interest in mineral rights on the irrigated place was valued by the buyer on the questionnaire and that amount deducted from the total price for this comparison. The well and well equipment were also deducted. The wheat allotments are similar, percentage-wise.

4-4W. Both of these farms had one-half of the mineral rights, but no indication of their value. The soils are Richfield, Colby, and Colby and Keith, with the same topography. The dry farm is twice as far from the nearest elevator, the two declared to be nine and eighteen miles, respectively.

5-5W. These farms were sold within a month of the same date. The irrigated land was actually the sale of only one-eighth interest in 640 acres, while the dry farm was 80 acres total. They are both under five miles from the nearest elevator. The soils are Richfield, Colby on the irrigated farm and Richfield, Dalhart on the farm without water, but both are well adapted to wheat production. The wheat allotment is 25% greater on the dry farm, but this is not considered to be a critical factor because it is only ten acres difference in total allotment. Mineral rights are included in both places, but no difference in value is apparent at the present time.

6-6W. The valuations placed on the mineral rights by the two owners have been deducted from the total purchase prices on the farms, as have the values placed on wheat allotments and other improvements. The wheat allotments, the sizes of the tracts, and the distances from the nearest elevator are all approximately the same. The sales dates are within three months of the same time. The soils and topography are the same. The purchaser of the irrigated land stated that another factor that influenced the price of the farm was that the land joined other land that he presently owned and was farming.

7-7W. Both of these are the same size, and both sold near the same time. The dry farm included only one-half of the mineral rights, while the irrigated farm included all mineral rights, but this factor did not appear to be important in arriving at the sale price. The soils are Ulysses and Richfield, which means that they

are very similar. There were no improvements on either place and the wheat allotments were about the same. The distances to the elevators were twelve and fourteen miles. The irrigated farm had no well at the date of sale, but the purchase was subject to an option providing that a test hole could be drilled by the purchaser and the presence of water verified or he would not be bound by the sales agreement.

8-8W. The soils on these two farms are very similar. There are no mineral rights with either place. However, the wheat allotment on the irrigated farm is 320 acres (100% of the land) against only 80 acres (50% of the land) on the dry farm. Both are four miles from the elevator, and owners had other land in the same area before purchase.

9-9W. Though the irrigated farm was known to have water at the time of sale, there were only 220 acres actually under cultivation that were being irrigated. The other 380 acres were rough and dry and considerable work had to be done to make it irrigable. The owner said that at the time of this survey there are only 54 acres that are not under irrigation.

10-10W. The mineral rights are included on both places, but the previous owner of the dry land has reserved them until his death, at which time they will go to the present owner. The wheat allotments on both places are small. The well on the irrigated place is very small, (only 350 gallons per minute), hence the small value placed on the water.

11-11W. These two farms have the same allotments, the same

distance to the elevator, near the same size of tract, and similar soils and topography, and they sold within one month of each other. However, the dry farm has mineral rights, the value of which is not given by the owner, and the irrigated farm has a 900 GPM well, the value of which has not been given. The comparison, though lacking in similarities, was the best available from the data.

12-12W. These farms were sold nine months apart. They were both the same size and both had mineral rights. The soils and topography are similar.

13-13W. These farms are 160 acres for the dry farm and 480 acres for the irrigated, the same soil types, and similar topography. Both include mineral rights and have similar relative wheat allotments. The dry farm is eight miles from the elevator, while the irrigated is only two. The purchaser of the irrigated land said that there was no water when he bought the first quarter, but he drilled and got a 2400 GPM well, so he bought two more quarter-sections.

14-14W. Both of these farms include mineral rights, both sold within two month of each other, and both had the same soil types and similar topography. They had the same wheat allotments, approximately, and distances to the nearest elevator were similar. The irrigated land had a well valued at $14,000.00, the value of which was deducted from the total purchase price before computing the per acre sale price.

15-15W. The irrigated land was sold at public auction, but the high bidder could not raise the money, so the neighbor bought the land to increase his own holdings. He considered the following

other factors important in arriving at a valuation of the property:

(a) only two miles from town,

(b) Owned adjoining land east, north, and west,

(c) the "new grain storage was a nice improvement" that he could use.

Over $57,000.00 worth of improvements were deducted from the total purchase price before computing the net price per acre. The price breakdown was complete and the information on the questionnaire indicated that this farmer kept better records than most of the others who participated in the survey.

The dry farm sale price was adjusted downward $2,400.00 in this case because of the following comment by the purchaser on his questionnaire: "Other factor which was considered in arriving at the value of this land; proximity to other owned land. If land had been away from our land, we would not have considered it at this price. Possibly $16,000.00 or less."

16-16W. These farms were both purchased in large tracts, 640 and 1600 acres, respectively. They both included mineral rights and are both predominantly Richfield loam soils. The irrigated farm had a small well on it, valued at $4,000.00, but the owner is planning to develop more water "as money permits." Both places have approximately one-quarter of the land as wheat allotment acreage. The dry farm is twenty-two miles from the elevator, while the other is only one mile away. It is interesting to note that the dry farm was purchased at a sheriff's sale, after which the owner drilled twenty-eight test holes, all of which were dry.

17-17W. Both farms have mineral rights, both have an equal percentage wheat allotment, the topography is the same, the soils are different, but both are fertile soils adapted to wheat production. The dry farm is 20 miles away from an elevator, while the irrigated in only two.

18-18W. The soils are both Richfield, Colby. The farms sold only about four months apart. Both places included mineral rights. The percentage wheat allotments were about the same. They were twelve and seventeen miles away from an elevator. The owner of the irrigated land listed as factors that affected the valuation of property as: "availability of a good tenant, type of soil, topography of land, and production history." Improvements amounting to $15,300.00 had to be deducted from the total purchase price of the irrigated farm before computing price per acre.

Summary of Data From Kansas Water Resources Board

After the questionnaires were all included in the compiled data, the information was checked for accuracy by comparison with information on file at the Kansas Water Resources Board in Topeka. Following is a summary of the findings.

From the "yes" group, (excluding the eighteen separated for more detailed study) there were only eleven which had water right applications filed. Nine of these eleven were filed after the date of sale, leaving only two that actually had water rights applications filed when the land transaction took place. Neither of these two were certificated, however.

From the "no" group, (excluding the eighteen separated for more detailed study) seven had filed application for water rights. Six of these seven were filed after the sale date. One bought the land and the approved, but not certificated, water right together. (He probably was in the "no" category because he misunderstood the questionnaire, or because no well was drilled, even though a water rights application had been filed.) All of the above may indicate, as pointed out by Robert Kerchner on page 35 of his report, that many people do not really know what the law is concerning water in their area, and it may even indicate that they are not aware of the meaning of the term "water right."

Of the eighteen "dry" farms, there were two with applications for water rights on file in the state office. One of these two was filed in connection with a well on a nearby tract owned by the same individual. The other was filed at approximately the date of sale, and was probably a speculation by the buyer on the likelihood of finding water.

From the eighteen irrigated farms, only fifteen had wells recorded in the files at the state office. However, there was one of the other three which was to be irrigated from a neighboring well (located on the property line) with water rights to be established by the purchaser. The information on the other two questionnaires was verified by telephone conversation with the respondents, though applications for water rights have not yet been filed.

## Regression Analyses

As was mentioned before, the average price per acre of the eighteen dry farms was $78.00. The average price per acre of the eighteen irrigated farms was $171.00, a difference of $93.00 per acre which could be attributed to the value of water. Since the farms were matched in a one-to-one comparison, it is possible to perform linear regression analysis of the relationships between water value and depth to water, water value and well capacity in gallons per minute, and also rank correlation between water value and time of sale for trend analysis.

A regression analysis using two independent variable, $X_1$ being depth to water, and $X_2$ being well capacity in gallons per minute, proved to be of little value. There is very little linear relationship between the depth to water and well capacity. The product moment correlation coefficient ($r_{x_1x_2} = .0616$) is not significant even at the 90% level.[39]

The regression coefficient is not reliable because the standard error is high. ($s_{b_1} = 1.6404$, $s_{b_2} = .1786$)[40]

A simple regression analysis, using depth to water as the independent variable, resulted in a product moment correlation coefficient of r= -.0123, with sixteen degrees of freedom, which is not significant at any level,[41] showing that there is very little

---

[39] Holly C. Fryer, Concepts and Methods of Experimental Statistics, (Boston: Allyn and Bacon, Inc., 1966), p. 594.

[40] Ibid., p. 566. The t values are not significant at even the 10% level with sixteen degrees of freedom in a two-tail test.

[41] Ibid., p. 594.

effect, if any, of depth to water on the price paid for water.

However, the product moment correlation coefficient for water, using the price difference as the dependent variable and the pump capacity in gallons per minute as the independent variable, was r = .5217, with fifteen degrees of freedom, which is significant at the 95% level, but not at 99% level. This value of r is large enough to justify computation of a prediction equation for the linear relationship. Consequently, by the method of least squares, a regression line was fitted to the graph in Figure 5, by use of the following:

$$Y = a + bX,$$

where Y = price of water, a = $\underset{(10.05)}{\$42.52}$, b = $\underset{(.0138)}{.0328}$, and X = well capacity in gallons per minute.

See Table 4 for the data. Following are the computations for the prediction equation.

$$\bar{X} = \frac{\Sigma X}{n} = 1356.$$

$$\bar{Y} = \frac{\Sigma Y}{n} = \$86.94.$$

$$a = \bar{Y} - b(X - \bar{X}) = \$42.52.$$

$$b = \frac{\Sigma(X - \bar{X})(Y - \bar{Y})}{\Sigma (X - \bar{X})^2} = .0328$$

TABLE 4

The Correlation Between Price of Water and Depth to Water, and Price of Water and Well Capacity in GPM

| Pair No. | Price per Acre Dry | Price per Acre Irrig. | (Y) Difference (Price of Water) | ($X_1$) Depth to Water | ($X_2$) GPM Well Capacity |
|---|---|---|---|---|---|
| 1 | $ 90.00 | $179.00 | $ 89.00 | 77 (feet) | 1000(GPM) |
| 2 | 46.00 | 169.00 | 123.00 | 120 | 2000 |
| 3 | 100.00 | 200.00 | 100.00 | 255 | 1200 |
| 4 | 125.00 | 231.00 | 106.00 | 260 | 2000 |
| 5 | 134.00 | 153.00 | 19.00 | 170 | 800 |
| 6 | 85.00 | 172.00 | 87.00 | -- | -- |
| 7 | 122.00 | 194.00 | 72.00 | 220 | 1400 |
| 8 | 72.00 | 141.00 | 69.00 | 160 | 1600 |
| 9 | 100.00 | 120.00 | 20.00 | -- | 350 |
| 10 | 110.00 | 175.00 | 65.00 | 205 | 900 |
| 11 | 60.00 | 150.00 | 90.00 | -- | 1500 |
| 12 | 115.00 | 229.00 | 114.00 | 83 | 2400 |
| 13 | 111.00 | 150.00 | 39.00 | 186 | 1500 |
| 14 | 58.00 | 116.00 | 58.00 | 40 | 200 |
| 15 | 100.00 | 275.00 | 175.00 | 200 | 1500 |
| 16 | 80.00 | 202.00 | 122.00 | 95 | 1200 |
| 17 | 52.00 | 155.00 | 103.00 | 90 | 2500 |
| 18 | 80.00 | 194.00 | 114.00 | 150 | 1000 |

-- Information not available.

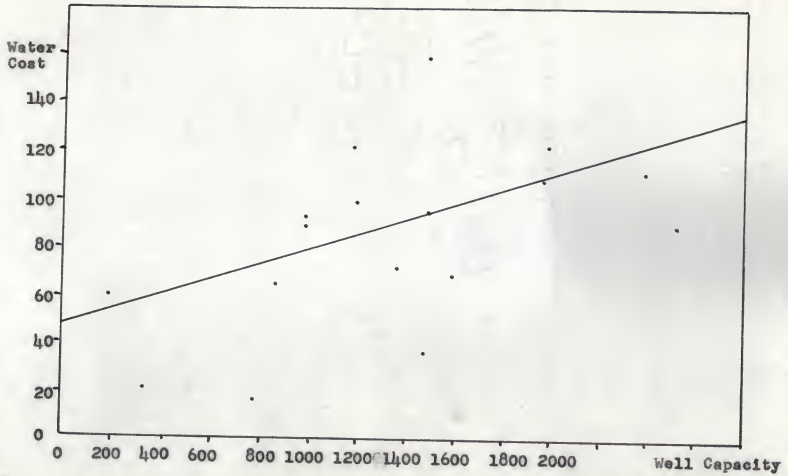


Figure 5. Graph showing correlation between price of water and well capacity.

## Adjustment for Trend

Previous mention has been made of the question of adjustment for trend. Using the data in Table 4, and making a chronological listing of the irrigated farms by months, the following data can be used to obtain a Spearman's rank-difference coefficient of linear correlation, $r_s$, by the following formula:

$$r_s = 1 - \frac{6\Sigma(d^2)}{n(n^2 - 1)}.$$

| Chronological Rank | Water Value Rank | (d) |
|---|---|---|
| 1 | 9 | 8 |
| 2 | 17 | 15 |
| 3 | 11 | 8 |
| 4 | 13 | 9 |
| 5 | 1 | 4 |
| 6 | 8 | 2 |
| 7 | 7 | 0 |
| 8 | 6 | 2 |
| 9 | 2 | 7 |
| 10 | 5 | 5 |
| 11 | 10 | 1 |
| 12 | 14.5 | 2.5 |
| 13 | 3 | 10 |
| 14 | 4 | 10 |
| 15 | 18 | 3 |
| 16 | 16 | 0 |
| 17 | 12 | 5 |
| 18 | 14.5 | 3.5 |

The coefficient $r_s = .1843$, with sixteen degrees of freedom, seems to indicate that there is very little, if any, trend. According to the table in Snedecor's book, this is not significant at the 5% level, which is as low as the table goes.[42]

---

[42] George W. Snedecor, Statistical Methods Applied to Experiments in Agriculture and Biology, (Ames, Iowa: The Iowa University Press, 1962), p. 174.

The significance test given by Fryer[43] is

$$\sigma_{rs} = \sqrt{\frac{1}{(n-1)}} = .2425$$

where a standard normal variate is

$$\lambda = \frac{r_s}{\sigma_{rs}} = .2194.$$

The standard normal cumulative frequency table in Fryer's[44] book shows that only about 22 times in 100 would there be need for trend adjustment.

Possibility of Bias Because of Mineral Rights

One factor that probably should be considered further is the presence or absence of mineral rights in the data. There were twelve of the eighteen pairs that had mineral rights, but no specific value stated by the landowners. Hence, there is the possibility of an error because of differences in mineral rights and their values.

In most cases it is true that when a farm is sold for agricultural purposes, unless there has been previous oil or mineral activity on the land, or on neighboring land, the mineral rights go with the land without much influence on the price. However, in the Hugoton Gas Fields, which are partially in the four county area of this study, there has been oil activity in the past.

---

[43] Fryer, p. 237.

[44] Ibid., p. 562.

In order to determine if there is some bias, the statistics advisor on this problem suggested locating all the pairs of farms on a map to see if they are randomly scattered. This was done, but because of the pledge made to the landowners in the letter of transmittal, that no names or tracts would be identified in published data, the map is not reproduced here. The opinion of the statistics advisor, and also of the author, is that the mineral rights are randomly scattered. Hence, the conclusions are probably not influenced by variations in mineral rights.

At least one point in favor of this can be made. The questionnaires which were returned by the landowners provided for a breakdown of value between mineral rights and surface rights. Those who failed to show the breakdown likely did so because they had not previously considered it to be an important major factor in valuation. However, it must be admitted, there is the possibility of error on this point.

A Comparison of Respondents and Non-respondents

There is one definite advantage that is present in the data used for this study, which is not normally found in mail survey studies, and that is the fact that some information, available from county records on both respondents and non-respondents, can be used to determine if there is any significant difference between those who returned the questionnaires and those who did not. The date of sale and the size of tract are known for both groups. The product moment correlation coefficient for date of sale is $r = .9590$,

and for the size of tract, r = .9979. The high correlation between the two groups would lead one to believe that the sample data is representative of the whole and can be assumed to be a random sample.

See Appendixes VI and VII for the detailed breakdown of the above information.

## SUMMARY AND CONCLUSIONS

The problem of isolating the value of water from the value of the land, and improvements thereon, was approached via the actual market comparison approach. Data was gathered on all the farms which changed ownership between 1962 and August, 1967. By questionnaire, the actual sales prices of approximately one-half of all the transactions during this time period were obtained. The data, though not a random sample, approximates a random sample, and is a large enough sample of the entire population that, statistically, it could be considered to be a representative sample, and therefore, useful for the purpose of this study. One basis for comparison of respondents and non-respondents is previously discussed on page 52.

The returned questionnaires were divided into two groups: those describing tracts which had water in the form of developed wells, or which the purchaser supposed had ground water when the land was purchased, and those describing tracts which purchasers thought did not have any ground water at the time of purchase. The average prices per acre paid by each of these groups of purchasers were $121.00 and $80.00, respectively. The difference of $41.00 is an average value of water. However, the difference between the two arithmetic means is a simple interpretation, disregarding many other factors which may have an effect on the value of land.

For this reason, a different type of analysis was made. There

were eighteen farms which definitely had water. These were matched with eighteen dry farms, alike in as many other respects as possible. The difference was attributed to the ground water. The average difference in price on these eighteen pairs was $93.00 per acre.

On fifteen of these eighteen farms, the depth to water was known, and on seventeen of the eighteen, the information on quantity of water, as measured by gallons per minute of well capacity, was known. Consequently, a regression analysis was run on both independent variables together, and then on each one separately. The results, showing the correlation between price of water and well capacity, appear to be both useful and significant. However, depth to water does not have a significant effect, nor does the thickness of the water bearing strata. Though neither of the last two mentioned factors showed any significance in this particular study, both of them will undoubtedly assume more importance in the future, as knowledge of ground water geology becomes more widespread and as water use becomes more widely practiced and competitive.

The prediction equation, $Y = \underset{(10.05)}{\$42.52} + \underset{(.0138)}{.0328}\ X$, where Y is the price of water and X is the well capacity in gallons per minute, was computed by the method of least squares. This equation indicates that the amount of water available for irrigation, in terms of well capacity, has a definite influence on the price of land. This is more of an effect than was indicated by the study by Edwards, Pine, and Feyerherm, but it is for a different time period and also for a different interpretation, so a rigorous comparison should not be made between the two.

The analysis of trend revealed that no adjustment for trend was necessary. The farms were matched on a one-to-one basis, and the dates of sale were almost all within six months of each other. Thus, the trend in land values was separated from the data, leaving only the trend in land values which could be attributed to water. Then, the regression analysis showed that the trend was not significant, with a Spearman rank correlation coefficient of $r_s = .1843$.

Soil types and topography were both matched very closely for every pair of farms, as can be seen from Tables 2 and 3. There is no need for adjustment for either of these.

An attempt, such as this, to extract some useful general information from such a small number of transactions, must take into account that there is a high possibility of error. This is especially true when the desired information is itself a factor which is influenced by such a large number of uncontrolled variables. The use of multiple regression analysis might be more desirable, but was not used in this paper. Such things as size of tract, accessibility of paved highways, acreage allotments, etc., have been considered only in so far as they can be similarly matched on a farm-to-farm basis between farms with water and farms without water.

Other factors, more subjective in nature, such as desirability as a home unit, ability to bargain, financial conditions and attitudes of buyers and sellers, knowledge of other opportunities, management abilities, etc., have not been considered.

There are probably numerous biases in this study, but the biases

probably offset each other, and the results are acceptable. The conclusions apply only to the four county area studied and we cannot generalize about the other areas of the state without further study. It is hoped that more work will be done along this line in the future.

APPENDIX I

DATA SHEET

Name and address of buyer _____

_____

_____

Name and address of seller _____

_____

_____

Relationship of buyer and seller _____

Date of Sale _____

Deed Register Data Book_____ Page _____ County _____

Amount of revenue stamps _____

Legal description of property _____

_____

_____

General information _____

_____

Soil types _____

Breakdown of sale price:

| | |
|---|---|
| Residence _____ | Other _____ |
| Farm buildings _____ | _____ |
| Fences _____ | _____ |
| Crops _____ | _____ |
| Machinery _____ | Land _____ |
| Wells and pumps _____ | Water _____ |

Source of information _____

APPENDIX II

KANSAS STATE UNIVERSITY
Manhattan, Kansas 66502

Department of Economics
Waters Hall

Section _____ T _____ R _____

Dear Sir:

Kansas State University is conducting a study of the effect of underground water supply on land values in southwestern Kansas. This study may be helpful to landowners in the future in establishing a basis for underground water depletion allowance on federal income tax. Such allowances have been granted in some areas in the Texas High Plains.

The county register of deeds shows that you acquired land in the above section within the last five years. Would you be kind enough to fill out the enclosed questionnaire and return it in the stamped, self-addressed envelope?

This information will be confidential and the published results will not identify individual owners or tracts of land.

Sincerely yours,

s/ E. S. Bagley
E. S. Bagley
Professor of Economics

APPENDIX III

QUESTIONNAIRE

Sec_____ T_____ R_____

Please answer all questions and state all values with respect to conditions existing at the time of purchase.

1. Total number of acres purchased _____

2. Total purchase price $_____

3. Did the purchase include any of the following — If your answer to any of the items listed on the left is yes, give the respective value. (The sum of the individual values should equal the purchase price.)

| | | |
|---|---|---|
| Residence | _____ | $_____ |
| Farm buildings | _____ | _____ |
| Fences | _____ | _____ |
| Crops | _____ | _____ |
| Wheat Allotments | _____ | _____ |
| Livestock | _____ | _____ |
| Machinery | _____ | _____ |
| Wells | _____ | _____ |
| Pumps, pipe, etc | _____ | _____ |
| Other | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| Water rights | _____ | _____ |
| Gas, oil, mineral | _____ | _____ |
| Land | _____ | _____ |
| | Total | _____ |

4. Did you know of the presence of underground water when you made the purchase? _____

5. Were there established water rights with the land? _____

6. If there was a well, what was the extent of the water supply? (Give information for each well.)

   Gallons per minute? _____

   Depth to water? _____

   Thickness of water bearing strata? _____

7. Are you now irrigating this property, either by ditch or sprinkler? _____

8. Did you own other land in the same area? _____ Were you irrigating it? _____

9. Are the buyer and seller related? _____ If yes, was the purchase price a fair market price? _____

10. Was the land purchased for agricultural use? _____

11. Wheat allotment (acres) _____

12. How many miles to the nearest elevator? _____

13. Other factors which were considered in arriving at the value of the land.

_____

_____

_____

APPENDIX IV. FARMS IN THE "WATER" CATEGORY

| Unit No. | Sale Date | Net Price | Tract Size | Price /Acre | Water GPM | Min Rts | Wheat Allot | Topo-graphy | Soil Types | Distance to Elev. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan 62 | $33000 | 320 | $103 | | Yes | 40 | 0-3% | Ra,Rb,Df,Vx | 10 | |
| | Nov 62 | 94408 | 628 | 150 | | Yes | 280 | | | 3 | Irrigated |
| | Aug 62 | 19000 | 160 | 119 | | Yes | Yes | 0-3 | Db, Ra, Vo | 8 | |
| | Oct 62 | 43000 | 240 | 179 | | Yes | Yes | 0-3 | Da, Db, Ua | 11 | Irrigated |
| | Nov 62 | 54000 | 320 | 169 | | Yes | 100 | | Vx Vo | 4 | Irrigated |
| | Jan 63 | 20000 | 160 | 125 | | ½ | 56 | | | 6 | |
| | Apr 63 | 17300 | 316 | 55 | | No | 21 | | Vo, Dx | 10 | Grassland |
| | Jul 63 | 31500 | 160 | 197 | | Yes | 57 | 0-1 | Ra, Ua | 8 | |
| | Aug 63 | 17000 | 160 | 106 | | Yes | 46 | 0-3 | Ra, Ub | 6 | Joined own land |
| | Oct 63 | 16000 | 160 | 100 | | ½ | 30 | | | 9 | |
| | Jan 64 | 120000 | 640 | 188 | | | 160 | | | 3 | |
| | Feb 64 | 32000 | 320 | 100 | | No | 110 | 0-1 | Ra, Ua | 17 | |
| | Mar 64 | 22500 | 160 | 141 | | Yes | 51 | 0-1 | Ra, Ua | 51 | Joined own land |
| | Jul 64 | 15000 | 160 | 94 | | Yes | 56 | | | 8 | |
| | Aug 64 | 20000 | 159 | 126 | | Yes | 51 | 0-1 | Ra, Ua | 6 | |
| | Oct 64 | 55200 | 320 | 172 | | Yes | 100 | 0-1 | Ra | 12 | |
| | Oct 64 | 46000 | 320 | 144 | | No | 320 | 0-1 | Ra, Ua | 4 | Joined own land |
| | Dec 64 | 51200 | 320 | 160 | | No | 145 | 0-3 | Ra, Db, My | 2 | |
| | Feb 65 | 84400 | 600 | 141 | | ½ | 198 | 0-3 | Ra, Ub | 4 | |
| | Jan 65 | 29300 | 320 | 92 | | ½ | 94 | 0-1 | Ra, Ua | 6 | |
| | Feb 65 | 61421 | 512 | 120 | | Yes | 38 | 0-1 | Ua, Ra | 10 | |
| | Mar 65 | 6800 | 160 | 42 | | Yes | 35 | 5-9 | Bx,Ub,Uc,Go | 13 | Joined own land |
| | May 65 | 25000 | 160 | 156 | | Yes | 42 | | | 10 | |
| | Aug 65 | 40000 | 320 | 125 | | Yes | 74 | | | 12 | Nearby land owned |
| | Aug 65 | 10000 | 80 | 125 | | Yes | | | | 10 | |
| | Sep 65 | 28160 | 160 | 176 | | | | | | 14 | |
| | Sep 65 | 5000 | 160 | 31 | | Yes | 60 | 0-1 | Ua | 12 | |
| | Oct 65 | 5400 | 320 | 17 | | No | -0- | Rough | | 15 | |
| | Nov 65 | 14000 | 80 | 175 | | Yes | 27 | | | 11 | |
| | Dec 65 | 31700 | 320 | 99 | | Yes | | | | 2 | |
| | Dec 65 | 32000 | 320 | 100 | | Yes | 100 | 0-1 | Ra, Ua, Lo | 17 | |
| | Dec 65 | 15200 | 160 | 95 | | Yes | 54 | 0-1 | Ra, Ua | 4 | |
| | Jan 66 | 21000 | 160 | 131 | | Yes | 155 | 0-1 | Ra, Uo | 2 | |
| | Apr 66 | 100400 | 480 | 209 | | Yes | 57 | 0-1 | Ra, Ua | 2 | |

APPENDIX IV. (Continued)

| Unit No. | Sale Date | Net Price | Tract Size | Price /Acre | Water GPM | Min Rts | Wheat Allot | Topo-graphy | Soil Types | Distance to Elev. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mar 66 | 26000 | 148 | 176 | | No | 42 | | | 2 | |
| | Jun 66 | 18350 | 160 | 115 | | No | -0- | 0-3 | Df, Vo | 6 | |
| | Apr 66 | 24000 | 160 | 150 | | | 51 | | | 11 | Irrigated |
| | Jul 66 | 54000 | 640 | 84 | | Yes | 160 | 0-1 | Rm | 1 | |
| | Apr 66 | 53000 | 1200 | 44 | | No | 295 | | | 7 | Sold in family |
| | Sep 66 | 22000 | 160 | 138 | | No | 52 | 0-1 | Ua, Rm | 12 | |
| | May 66 | 74000 | 320 | 231 | | Yes | 101 | | | 2 | Irrigated |
| | Oct 66 | 15000 | 160 | 94 | | No | 43 | 0-1 | Ua, Rm | 15 | |
| | Nov 66 | 30000 | 320 | 94 | | No | 97 | 0-1 | Rm | 1 | |
| | Dec 66 | 12000 | 78 | 154 | | Yes | 47 | | | 7 | Sold in family |
| | Jan 67 | 6400 | 80 | 80 | | Yes | 26 | 0-5 | Ub, Ua | 2 | Rough land |
| | Mar 67 | 15000 | 106 | 142 | | No | -0- | 0-3 | Df, Vo | 5 | |
| | Apr 67 | 64600 | 320 | 202 | | Yes | 119 | 0-5 | Rm,Ub,Ua,Ox | 17 | |
| | Nov 62 | 8000 | 160 | 50 | | Yes | 32 | | | 4 | Sold in family |
| | Feb 64 | 32600 | 240 | 123 | | Yes | 81 | | | 5 | |
| | Sep 64 | 17750 | 160 | 111 | | Yes | 46 | | | 6 | |
| | Jun 63 | 52500 | 338 | 155 | | Yes | 105 | 0-3 | Ua, Ue, Rm | 8 | |
| | Apr 66 | 11130 | 160 | 70 | | Yes | 47 | | | 9 | |
| | Aug 66 | 72000 | 320 | 225 | | | 100 | | | 2 | |
| | Aug 64 | 25000 | 160 | 156 | | | 87 | | | 2 | |
| Totals | | 1847327 | 14645 | 126 | | | | | | | |

APPENDIX V. FARMS IN THE "DRY" CATEGORY

| Sale Date | Net Price | Tract Size | Price /Acre | Min Rts | Wheat Allot | Topography | Soil Types | Distance to Elev. | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Jan 62 | $18000 | 160 | $112 | ½ | 55 | 0-1 % | Ua | 5 | |
| Jan 62 | 12800 | 160 | 80 | | 77 | | Vx, Dx | 8 | |
| May 62 | 13500 | 150 | 90 | No | 50 | 0-1 | Da, Ra, Vo | 12 | |
| Mar 62 | 6250 | 160 | 40 | Yes | | | Vo, Tv, Df | 2 | |
| Jun 62 | 38400 | 480 | 80 | | | | | 1 | |
| Mar 62 | 3000 | 136 | 22 | | -0- | Windblown | Bo, Vo, Df | 16 | |
| Aug 62 | 19500 | 154 | 127 | No | 87 | 0-1 | Ra, Vo | 7 | Joined own lan |
| May 62 | 7360 | 160 | 46 | No | -0- | | Vo, Vx | 5 | |
| Oct 62 | 14400 | 160 | 90 | Yes | 47 | 0-1 | Ra, Ua, Ub | 9 | |
| May 62 | 9000 | 320 | 28 | | 54 | 0-1 | Ue, Go | 15 | Rough land |
| Nov 62 | 46000 | 474 | 97 | No | 100 | 0-3 | Ra, Da, Vo | 7 | Drilled well 8 |
| Jun 62 | 8000 | 107 | 75 | Yes | -0- | 0-3 | Df, Lp | 14 | |
| Nov 62 | 16800 | 157 | 107 | No | 15 | | Vo | 4 | |
| Apr 62 | 12000 | 160 | 75 | No | Yes | 0-1 | Ra, Rb | 10 | |
| Jan 63 | 15800 | 158 | 100 | No | 92 | | | 2 | Near own land |
| Nov 62 | 11500 | 160 | 72 | Yes | 54 | | | 6 | |
| Jun 63 | 12000 | 160 | 75 | Yes | 52 | 0-1 | Ra, Ua | 7 | |
| Nov 62 | 14000 | 160 | 88 | Yes | 54 | | | 18 | |
| Jul 63 | 32000 | 320 | 100 | | 92 | | | 2 | |
| Mar 63 | 7400 | 148 | 50 | | -0- | 0-3 | Df, Rb | 10 | |
| Dec 63 | 15000 | 160 | 94 | Yes | -0- | | Vo, Vx | 10 | |
| May 63 | 32500 | 320 | 102 | | 100 | 0-3 | Ra, Db, Ub | 15 | |
| Jan 64 | 17800 | 160 | 111 | Yes | 130 | 0-3 | Ra, Dx, Db | 5 | |
| Jun 63 | 11500 | 80 | 144 | | -0- | 0-1 | Ra | 5 | |
| Jan 64 | 20000 | 160 | 125 | Yes | 50 | 0-1 | Ra | 9 | |
| Jan 64 | 18175 | 160 | 114 | Yes | 53 | 1-3 | Ua | 2 | |
| Feb 64 | 5700 | 75 | 76 | No | -0- | | | 1 | |
| Jan 64 | 11000 | 110 | 100 | Yes | 35 | 0-3 | Ub, Ue, Ra | 20 | |
| Mar 64 | 8300 | 160 | 52 | No | 56 | 0-3 | Ua, Ue | 8 | |
| Jan 64 | 19765 | 160 | 124 | Yes | 53 | 0-1 | Ra, Ua | 2 | |
| Mar 64 | 12000 | 160 | 75 | No | -0- | 0-3 | Ox, Ue | 18 | |
| Feb 64 | 8000 | 80 | 100 | Yes | 42 | 0-1 | Ra, Db | 4 | |

APPENDIX V. (Continued)

| Sale Date | Net Price | Tract Size | Price /Acre | Min Rts | Wheat Allot | Topography | Soil Types | Distance to Elev. | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Mar 64 | 7100 | 160 | 44 | No | -0- | 0-3 | Cb, Ua | 15 | Pasture land |
| Apr 64 | 27200 | 320 | 85 | ½ | | 0-1 | Ua, Ub | 14 | Sold for more in |
| Apr 64 | 20400 | 160 | 128 | Yes | 15 | 0-1 | Rm | 15 | Joined own land |
| May 64 | 50400 | 480 | 105 | | 183 | | | 10 | |
| Oct 64 | 46080 | 640 | 72 | Yes | 221 | 0-1 | Ra, Ua | 12 | |
| Jul 64 | 19500 | 160 | 122 | | 80 | 0-3 | Da, Df | 4 | |
| Jan 65 | 18400 | 160 | 115 | Yes | 34 | 0-1 | Rm | 8 | Joined own land |
| Feb 65 | 13250 | 106 | 125 | | 35 | | | 2 | " " " |
| Mar 65 | 9600 | 160 | 60 | Yes | | 0-3 | Ra, Ua, Ub | | |
| Mar 65 | 15400 | 160 | 96 | Yes | | 0-3 | Ra, Ub | | |
| May 65 | 3970 | 158 | 25 | Yes | 53 | 0-5 | Ra, Ua, Uc | 5 | |
| Jun 65 | 15750 | 160 | 98 | Yes | -0- | 0-3 | Df, Ra, Vo | 4 | On highway |
| Jul 65 | 90690 | 1600 | 57 | Yes | 329 | 0-3 | Rm, Ua, Ub | 22 | |
| Aug 65 | 32000 | 320 | 100 | Yes | -0- | | | 4 | |
| Nov 65 | 17080 | 160 | 107 | Yes | 56 | | | 8 | Water across road |
| Dec 65 | 25200 | 280 | 90 | Yes | | | | 16 | Joined own land |
| Dec 65 | 8650 | 80 | 108 | Yes | 28 | | | 10 | |
| Dec 65 | 24800 | 160 | 155 | Yes | 55 | | | 4 | |
| Mar 66 | 10000 | 80 | 125 | Yes | 31 | 0-1 | Rm, Ua | 14 | Sold in family |
| Feb 66 | 5867 | 53 | 111 | Yes | -0- | | | 17 | |
| Mar 66 | 24000 | 160 | 150 | Yes | 25 | | Tv, Vo | 7 | Sold in family |
| Mar 66 | 11000 | 80 | 138 | Yes | 62 | | | 10 | Joined own land |
| Jun 66 | 18400 | 160 | 115 | Yes | -0- | 0-3 | Rm, Ub, Tv | 4 | |
| Apr 66 | 20358 | 313 | 65 | No | | | | 15 | Joined own land |
| Jul 66 | 3000 | 40 | 75 | | 15 | | | 2 | |
| Nov 66 | 12350 | 160 | 77 | Yes | 51 | | | 12 | |
| May 67 | 8400 | 160 | 52 | Yes | 52 | 0-3 | Cb, Go | 20 | |
| Dec 66 | 14000 | 160 | 88 | | | | | 10 | |
| Jun 67 | 10800 | 80 | 135 | No | | 0-3 | Df, Vo | 5 | |
| May 66 | 12800 | 160 | 80 | No | | | Ue, Px | 20 | |
| Jun 66 | 11180 | 153 | 73 | Yes | 46 | 0-3 | Rm, Ub, Ue | 9 | |
| Total | 1115265 | 13092 | 85 | | | | | | |

## APPENDIX VI

Comparison Between Respondents and Non-respondents by Size of Tract

| Size of tract | Those who did not respond | Those who did respond |
|---|---|---|
| 40 acres | 2 | 2 |
| 80 | 19 | 17 |
| 120 | 3 | 6 |
| 160 | 100 | 82 |
| 240 | 0 | 4 |
| 320 | 29 | 27 |
| 480 | 3 | 7 |
| 640 | 5 | 6 |
| Over 640 | 2 | 2 |

APPENDIX VII

Comparison Between Respondents and Non-respondents by Date of Sale

| Date of Sale | Those who did not respond | Those who did respond |
|---|---|---|
| 1962 | 36 | 26 |
| 1963 | 26 | 22 |
| 1964 | 31 | 28 |
| 1965 | 34 | 35 |
| 1966 | 24 | 35 |
| 1967 | 12 | 7 |

# BIBLIOGRAPHY

American Institute of Real Estate Appraisers. Appraisal Terminology and Handbook. New York: 1954.

Bagley, Edgar S. "Water Rights Law and Public Policies Relating to Ground Water 'Mining' in the Southwestern United States," The Journal of Law and Economics, Vol IV, October, 1961.

_____. "Ground Water Depletion Under Federal Income Tax Law," The Kansas Agricultural Situation. Kansas State University, May, 1964.

Bidwell, O. W. Major Soils of Kansas. Topeka, Kansas: Agricultural Experiment Station, Kansas State University, 1956.

Bonbright, James C. The Valuation of Property, 2 volumes. Charlottesville, Virginia: The Michie Company, Law Publishers, 1965 reprint.

Edwards, Jack D., Wilfred H. Pine, and Arlin M. Feyerherm. Effects of Roads and Other Factors on Farm Real Estate Values in Kansas. Agricultural Experiment Station, Kansas State University, 1964.

Friedman, Edith J. (editor). Encyclopedia of Real Estate Appraising. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1959.

Fryer, Holly C. Concepts and Methods of Experimental Statistics. Boston: Allyn and Bacon, Inc., 1966.

Hutchins, Wells A. The Kansas Law of Water Rights. Topeka, Kansas: 1957.

Kansas General Statutes, 1949, Section 82a-702.

_____. Section 82a-711.

Kansas State Geological Survey. Geohydrology of Grant and Stanton Counties, Kansas. Lawrence, Kansas: University of Kansas, Bulletin 168.

Kansas Water Resources Board. State Water Plan Studies, Part A, Preliminary Appraisal of Kansas Water Problems. Section 2, Cimarron Unit, September, 1958.

Kerchner, Robert Bennett. The Knowledge of and Attitudes Toward Kansas Water Rights Law of Irrigators In the High Plains of Western Kansas. Unpublished Master's report, Kansas State University, 1960.

Latta, Bruce. Geology and Ground Water Resources of Stanton County, Kansas. Topeka, Kansas: University of Kansas Publication, Bulletin 37, 1941.

Marsh, Charles andWilfred H. Pine. The Value of Farm Real Estate, Manhattan, Kansas: Agricultural Experiment Station, Kansas State University, 1957.

McLaughlin, Thad G. Geology and Ground Water Resources of Morton County, Kansas. Topeka, Kansas: University of Kansas Publication, 1942.

Nelson, David Michael. The Value of Water For Irrigation in the Kansas River Valley. Unpublished doctoral dissertation, Kansas State University, 1968.

Pfister, Richard. Water Resources and Irrigation. Lawrence, Kansas: University of Kansas, 1955.

Pine, Wilfred H. and William Scofield. The Farm Real Estate Market in Kansas. Manhattan, Kansas: Agricultural Experiment Station, Kansas State University, 1961.

Ramsbacher, Harold H., et al. Trends in Land Valuesin Kansas. Manhattan, Kansas: Agricultural Experiment Station, Kansas State University, 1960

Ratcliff, Richard U., G. Graham Waite, and Dean T. Massey. "Rules of Compensability, Valuation and Evidence in Highway Land Acquisition," (Unpublished study, University of Wisconsin, September, 1967.)

Ring, Alfred A. The Valuation of Real Estate. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1963.

Snedecor, George W. Statistical Methods Applied to Experiments in Agriculture and Biology. Ames, Iowa: The Iowa University Press, 1962.

U. S. Department of Agriculture, Soil Conservation Service and Forest Service in cooperation with Kansas Agricultural Experiment Station. Soil Survey, Morton County, Kansas. Washington, D. C.: U. S. Government Printing Office, 1963.

_____. Soil Survey, Stanton County, Kansas. Washington, D. C.: U. S. Government Printing Office, 1963.

_____. Soil Survey, Stevens County, Kansas. Washington, D. C.: U. S. Government Printing Office, 1961.

Field Enterprises Educational Corporation, World Book Encyclopedia. Chicago: 1965.

# THE EFFECT OF UNDERGROUND WATER SUPPLY ON LAND VALUES IN SOUTHWESTERN KANSAS

by

SAMUEL HECTOR LEE

B. A., Fort Lewis College, 1966

---

AN ABSTRACT OF MASTER'S THESIS

Submitted in partial fulfillment of the requirements for the degree

MASTER OF ARTS.

Department of Economics

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1968

This thesis considers the effect of underground water supplies on the value of land in four counties in southwestern Kansas. Inasmuch as the market for real estate is an imperfect market, with every piece of property different in some respect from any other, and relatively few actual market transactions, the isolation and determination of this effect is a complex task.

Several approaches could be made to estimating the value of an income-earning asset, some of which are: (1) the replacement cost approach, which would not be applicable to land because land is not replaceable, (2) the income approach, (3) the market comparison approach, and (4) the market simulation approach. A multiple regression analysis could also be used, but is not the purpose of this paper.

The market comparison approach was the method chosen for this study, primarily because precedent had been established in a federal court, viz., Internal Revenue Service vs. Shurbet, wherein the court upheld Shurbet's claim for water depletion allowance. The cost of the water was determined by a market comparison of land with water with similar land without water. Another reason that the market comparison approach was used is that the data for the study was relatively easy to obtain.

This study does not attempt to evaluate all of the factors that may contribute to the determination of land prices. Instead, the objective is to compare value of farms with underground water, in quantities adequate for irrigation, with those farms without underground water. The other factors which affect value are accounted for by keeping the farms, themselves, as much alike in all other

respects as possible. By doing this with a representative sample of the two kinds of farms in the four county area which have actually changed hands at prices that were the result of free market forces, the desired effect can be isolated.

A suitable time period for samples of sales data was determined to be five years. Data was gathered by personal visit to each of the county Register of Deeds offices. A total of three hundred twenty-five farms, which could be used in this study, were sold during the given period. Questionnaires were mailed to all of the owners, and approximately one-half of these were returned with the requested information. From these, the transaction price was determined for each farm and the price per acre computed.

The data was separated into the two groups, analyzed, and an arithmetic mean calculated for each group. The difference in price for farms with water and those without water was $41.00 per acre, which difference could be attributed to water.

However, the above mentioned groups were composed mostly of farms without wells or test-holes, the decision as to whether there was water under the surface being left to the landowner. In many cases, the decision could have been wrong. Hence, it was decided to separate a group of farms which definitely had water, of which there were eighteen, and match them as nearly as possible to eighteen farms which were thought to lack underground water. The difference in price in this case was $93.00 per acre, which is probably a more realistic estimate of the value of water.

Also, using these eighteen pairs, a simple regression analysis of the relationship between the difference in the price of land with

water and the land without water, and the capacity of the well, was determined by the following prediction equation:

$$Y = \underset{(10.05)}{42.52} + \underset{(.0162)}{.0328}\ X,$$

where Y is the price of water, and X is the well capacity in gallons per minute. The product moment correlation coefficient, which measures degree of association between the variables, is r = .5217, and the coefficient of determination, which measures the percentage of explained variation, is $R^2$ = .2721.

There are probably numerous biases in this study, such as the value of mineral rights, buyers unable to avoid paying high prices set by sellers who were not particularly anxious to sell, or sellers who were forced to take low prices because of reluctant buyers, etc. However, because of the large sample size of approximately one-half of the total population and the randomness of the sample, the biases probably tend to offset each other and the conclusions have some validity.

Because of the fact that some information was available on those tracts of land which were owned by non-respondents, as well as tracts owned by the respondents, it was possible to test statistically to see if the two were from the same population. That is, were those who responded to the questionnaire different in any way from those who did not? The tests showed that no differences were evident, consequently, it was assumed that the sample was random.