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SUMMARY

The primary objective of this study was to establish an empirical estimate of the riskiness of various crops in different regions of Nebraska. For this purpose the variate difference method was used to estimate random variability indexes of prices, yields, and net returns for six Nebraska crops. The period of analysis included 1957-1976 and one county in each of the eight crop reporting districts was analyzed. Where relevant, both dryland and irrigated alternatives were examined.

Wheat exhibited the lowest and soybeans the highest price variability of the six crops analyzed. Alfalfa, oats, and grain sorghum were in an intermediate position in regard to price risk.

When yield was considered, either irrigated corn or irrigated alfalfa exhibited the lowest variability of all crop alternatives examined. Where both dryland and irrigated alternatives for a crop were considered (corn, alfalfa, grain sorghum, and soybeans), the irrigated alternative was almost always lower in variability than its dryland counterpart. Among dryland crops (the

above plus oats and wheat), a considerable variability in yield risk rankings occurred depending upon areas of Nebraska. In the North and Northwest, corn had the lowest yield variability of all dryland crops while in the Northeast, Central, East, and Southwest alfalfa was the least variable. Wheat proved to be the least variable dryland crop in the South and Southeast.

Net return variability, which combines the effects of price, yield, and cost of production variability, proved to be considerably higher than yield variability and had a less consistent pattern between dryland and irrigated crops. Irrigated corn had the lowest net income variability of all crops for all areas. The second least risky crop was dryland wheat in the Southwest, Southeast, and Northwest areas; irrigated soybeans or irrigated grain sorghum in the Northeast, Central, North and South; and dryland alfalfa in the East. Oats or dryland alfalfa had the highest net income variability in all areas except the East where dryland corn proved the most variable.

Interpret the results with caution due to shortcomings in data and methodology used. However, results are representative of the relative riskiness of the various field crops, keeping in mind that the estimated variability indexes are only an approximation of the true variation.

Most business decision-makers accept more risk only under the conditions that the probability of higher returns accompany risky choices. The authors believe that information in this report can be used by Nebraska farmers when deciding what crops to grow. Variability indexes can provide information regarding the riskiness of the various enterprises. The authors recognize that diversification can also be a useful approach to decrease net return variability along with insurance, commodity programs, and more sophisticated risk reducing strategies.

Price, Yield and Net Income Variability for Selected Field Crops and Counties in Nebraska

Boris E. Bravo-Ureta and Glenn A. Helmers[1/]

INTRODUCTION

Agricultural production, like many other economic activities, is subject to constant fluctuations forcing producers to make planning decisions with only limited information of future conditions. This framework of imperfect knowledge leads to a distinction between risk and uncertainty. Knight (1921) says risk refers to events whose probability distribution can be empirically evaluated. In contrast, uncertainty refers to events whose parameters cannot be measured statistically. Consequently, any empirical study measuring variability is an attempt to remove the farmer from an uncertain into a risk or statistically predictable planning environment. Thus, it is desirable to identify and quantify the sources contributing to variability in crop production.

Primary sources of risk in crop production stem from variability in prices and yields. Yields are subject to random variations due to weather conditions as well as systematic variations caused by technological improvements. Likewise, crop prices tend to move systematically with general economic conditions and randomly due to a variety of unpredictable events.

Producers typically decide what crops to plant based on past experience, which in some cases might be quite limited (e.g., new farmers) or perhaps biased due to short or selective memory. Furthermore, individuals' subjective preferences or perception of risk and uncertainty can also play an important role in production decisions. These perceptions are often strongly influenced by recent occurrences. The lack of objective information about variability makes it desirable to develop a measure that can be used by farmers to improve and facilitate the decision-making process.

Comparisons are often made between risk of dryland and irrigated production. It is generally suggested that a major factor influencing irrigation investments is the reduction of risk compared to dryland production. A lack of quantifiable measures of production risk between irrigated and dryland production underscores the need to estimate such parameters.

It is commonly agreed that the variability of net returns is composed of a

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systematic and a random or unsystematic component. There is less agreement, however, as to which of these two measures is more important as a tool for planning purposes. Dean and Carter have argued that "imperfect knowledge of the future stems primarily from the random or unpredictable component" and consequently farmers would be more interested in a measure of this component (p. 44). The same view was adopted later by Mathia, and Yahya and Adams. The basic rationale for giving added weight to random variability stems from the assumption that general trends have similar effects on all enterprises and such effects can be anticipated.

More recent work in risk management has made a clear distinction between the implications of systematic and random variability to the planning process. This distinction lies on the fact that systematic variation cannot be reduced by diversification while random or unsystematic risk can be eliminated by diversification (Tinic and West).

The objective of this paper is to compare the impact of using total and random variance on the ranking of different crops according to their riskiness. Two alternative variability measures will be developed for prices, yield, and gross margins[2/] for major field crops in eight counties in Nebraska.

STATISTICAL METHODOLOGY

The Variate Difference Method

The variate difference method, developed by Tintner (1940), was the statistical procedure used. Similar studies in California (Dean and Carter), North Carolina (Mathia), and Wyoming (Yahya and Adams) have used this approach to estimate crop variability indexes. The essential assumption of this method is that economic time series data consist of two additive parts—a mathematical expectation or systematic component and a random element. The systematic component of the variation in an economic time series corresponds to technological changes and long-run trends such as price cycles and inflation. The random element is a consequence of purely random or unpredictable events. A convenient feature of this method is that it does not require any specific assumptions about the functional form of the systematic component.

The variate difference method eliminates the systematic component of a times series by successive finite differencing leaving an estimate of the random element. This method requires the calculation of the variance of the original series and that of the successive finite differences. When a finite

2/ In this study gross margins, net income, and net returns are used synonymously.

difference of the order k_o is found "such that the variance of the k_o^{th} difference is equal to that of the $(k_o + 1)^{th}$ difference and equal to that of the $(k_o + 2)^{th}$ difference, etc., then we shall be justified in assuming that we have eliminated the mathematical expectation to a reasonable degree by taking k_o differences" (Tintner, 1940, p. 33). The variance of the random component is the one estimated for the k_o^{th} difference. Tintner suggests that these variances can be considered equal when the differences become numerically smaller than three times its standard error. An alternative approach is to estimate the variances for several differences and select the appropriate one by inspection. In this study the latter approach was followed (Tintner, 1952, pp. 313-321).

An important assumption inherent in any methodology that uses historical data to estimate future outcomes is that there exists a close relationship between the past and the future. Specifically, in this study it is assumed that past variability is good indication of future variability; thus empirical estimates based on historical data should provide a good indication of future risk.

Measurement of Variability for Specific Crops

These two measures were used to compute total and random crop variability indexes for prices, yields, and net returns. The formulas utilized for the calculations were:

$$\text{Total Variability Index} = \frac{\text{Total Variance}}{\text{Mean}} \times 100$$

$$\text{Random Variability Index} = \frac{\text{Random Variance}}{\text{Mean}} \times 100$$

The issue regarding the use of relative variance compared to absolute variance is important when comparing alternative crop activities. Absolute variance has been used as a conventional measure of risk, although it has been recognized that measures other than variance may contribute to a better risk definition. In addition, some risk analysts prefer a "safety first" risk concept where the probability of an occurrence below a critical point is used as a risk measure. Absolute variance or its approximation is used in risk programming models of the firm. However, for non-programming purposes of risk evaluation, enterprises should be examined on a relative variance basis. When activities differ widely in their input and output density, it can be argued that a relative measure of variability is preferred over an absolute measure. For instance, absolute yield variability for an irrigated crop may well be higher than its dryland counterpart, yet relative to output or inputs such as labor and capital, the variability of the irrigated crop may be less. Thus, relative variance was used to compare the total and random risk of different crops because standardizing by the means allows a more meaningful comparison between crops of different intensities of production.

Data

To account for the differences characterizing the various regions of Nebraska, eight counties were selected arbitrarily—one from each crop reporting district. Counties and reporting districts chosen were Morrill (Northwest), Brown (North), Madison (Northeast), Sherman (Central), Butler (East), Lincoln (Southwest), Kearney (South), and Thayer (Southeast).

The analyses included six of the major field crops grown in the state—alfalfa, corn, grain sorghum, soybeans, oats, and wheat. Yields and net returns from irrigated and nonirrigated land were analyzed for the first four crops, and only for dryland in the remaining two. Variability indexes were computed for 10 crops in each county, except for soybeans the production of which was insignificant in some areas (i.e., Morrill, Brown and Lincoln Counties).

The period of analysis covered a 20-year span from 1957 to 1976. The data for crop prices and yields were obtained from *Nebraska Agricultural Statistics,* Annual Reports. Output price data correspond to the yearly average of prices received by Nebraska farmers and yield information is based on harvested acreage in each county. Using only harvested acreage yields might lead to a downward bias of variability. Further, it leads to a distortion between the relative variability of dryland and irrigated yields understating the true variability of dryland relative to the irrigated production. The latter would happen if a higher proportion of planted dryland acres were not harvested compared to irrigated acres in drought years. A correction for this potential deficiency was not possible due to a lack of data.

Input prices were calculated by adjusting 1976 input prices, the base year for this study, by the Index of Prices Paid by Farmers (U.S.D.A., Agricultural Statistics) to estimate explicit dollar prices for the preceding years. An attempt was made to use the indexes that most closely correspond to the various inputs considered.

Net returns were computed by subtracting from gross returns (yields per acre X price per unit) the variable production costs. Thus, the net return figures represent a return to land, management and other fixed resources. This measure of returns is often referred to as gross margins.

The variable production costs were estimated from budgets developed by the Farm Management Extension Staff in the Department of Agricultural Economics at the University of Nebraska (Bitney, *et. al.).* To account for technological changes in agricultural production, the budgets were modified by adjusting production coefficients according to the production and efficiency indexes estimated by the U.S.D.A. (U.S.D.A., 1977). Again, the production coefficients were adjusted by those indexes most closely associated with the various inputs included in the budgets. Even though this procedure is open to criticism, possible distortions stemming from this approach are expected to affect all crops similarly, resulting in appropriate relative estimates.

All calculations leading to the gross margin estimates were expressed in nominal terms. These estimates were then expressed in real dollars using the Consumer Price Index based on 1967 = 100. In the analyses that follow, gross margins are expressed in real terms. The analysis dealing with output prices is also in real terms; however, the index used to arrive at constant dollars was the Wholesale Price Index for farm products based on 1967 = 100. The effect of adjusting net returns to account for inflation is to reduce the systematic variation caused by the general price level trend.

EMPIRICAL RESULTS

The empirical estimates of the variability indexes for prices, yields, and net returns for the crops and counties under consideration are presented in this section.

Price Variability

Table 1 shows the average real prices received by Nebraska farmers, their random and total standard deviations and their variability indexes for the six crops under consideration. The crops have been ranked from lowest to highest in random variability. They range from a low of 2.53% for wheat to a high of 7.66% for soybeans. This reveals a narrow spread and a fairly stable behavior evidenced by relatively low random variability indexes.

Table 1. Variability indexes of average real prices received by Nebraska farmers for selected crops (1967 = 100).[a]

		Real price	Standard deviations		Variability indexes	
Crop	Unit	Mean	Total	Random	Total	Random
Wheat	bu.	1.58	.33	.04	20.88	2.53
Corn	bu.	1.11	.15	.03	13.51	2.70
Alfalfa	ton	18.53	3.65	.89	19.69	4.80
Oats	bu.	.66	.07	.04	10.60	6.06
Sorghum	bu.	.95	.14	.06	14.73	6.32
Soybeans	bu.	2.48	.19	.19	16.93	7.66

[a] 1957-76 for all crops.

The low variability index for wheat prices relative to other crops tends to confirm earlier Nebraska research (Lutgen and Helmers) where simulated farm income variances were obtained from alternative crop plans and then compared on a coefficient of variation basis. That study, however, found corn to have an apparently higher level of relative variability than soybeans. Those results were conducted on a total rather than a random variance basis. Results reported here, either on a total or random basis, show soybean price variability to be high relative to corn price variability. The apparent difference in price variability conclusions for corn and soybeans may have resulted from the historical prices analyzed; 1961-75 for the Lutgen-Helmers study and 1957-76 for this analysis. In addition, the Lutgen-Helmers analysis examined soybean price variability only in combination with other crops.

The total variability indexes are relatively low and, the range between crops is narrow from 10.60% for oats to 20.88% for winter wheat. The use of real prices for the analysis eliminates a major portion of the systematic variation, thus the low levels in the total variability indexes.

Wheat, corn, and alfalfa prices exhibit the greatest relative decrease in variability when analyzed on a random variability basis. This indicates a greater systematic (apart from deflation) trend in these crops relative to others. Oats exhibit the lowest systematic trend with grain sorghum and soybean prices reflecting intermediate reductions due to trends.

Real and nominal price movements for the crops are presented in graphic form in Appendix 1.

Yield Variability

During the study period there was a significant increase in yields stemming from both technological innovations and increased level of input use including irrigation, mechanization fertilizers, improved crop varieties, better seeds, etc. In this study the particular functional form of the trend is not relevant and only yield fluctuations not related to the trend are assumed to be random.

Table 2 presents the estimated total and random variability yield indexes for six major field crops in the eight Nebraska counties. These indexes have been ranked from lowest to highest according to the magnitude of random yield variability for each county separately.

The random variability indexes ranged from a low of 3.76% for irrigated corn in Lincoln County, to a high of 27.64% for dryland grain sorghum in the same county. In general, irrigated crops showed a relatively lower random yield variability index across all counties than did dryland crops. In three counties, Madison, Kearney and Thayer, all irrigated crops showed

Table 2. Total and random variability indexes of yields, means yields, and proportion of acreage for selected crops in eight Nebraska counties.[a/]

Crop	Variability index: Total	Variability index: Random	Mean yield[b]	1975-76 proportion of acreage
Madison (Northeast)				
	---------percent---------			(percent)
Irrigated alfalfa	9.47	6.05	3.8	1.0
Irrigated soybeans	10.94	9.90	32.8	1.5
Irrigated corn	17.51	10.18	96.3	15.9
Irrigated grain sorghum	17.33	10.87	81.2	.1
Dryland alfalfa	14.23	11.53	2.6	9.8
Dryland corn	30.76	15.58	53.5	40.5
Dryland soybeans	21.04	17.23	22.1	20.4
Dryland grain sorghum	23.94	17.44	54.5	2.2
Oats	28.53	19.38	37.5	8.4
Wheat	32.84	26.62	26.7	.4
Sherman (Central)				
Irrigated corn	20.59	4.34	92.9	29.9
Irrigated alfalfa	14.86	7.56	3.7	4.8
Irrigated grain sorghum	17.06	7.90	76.3	.5
Dryland alfalfa	15.00	10.55	1.8	29.2
Dryland corn	26.20	14.05	34.3	16.2
Irrigated soybeans	17.43	14.09	32.0	.3
Dryland grain sorghum	22.63	16.51	37.6	7.2
Dryland soybeans	17.82	17.82	17.9	.5
Wheat	34.51	18.58	26.8	8.9
Oats	23.23	23.23	30.9	2.6
Morrill (Northwest)				
	---------percent---------			(percent)
Irrigated alfalfa	13.33	7.57	3.3	17.2
Irrigated corn	17.56	11.86	78.4	30.9
Dryland corn	38.64	15.65	24.4	3.3
Wheat	18.92	16.12	27.1	40.5
Oats	18.07	17.18	35.9	1.5
Irrigated grain sorghum	20.77	18.66	64.6	.1
Dryland alfalfa	24.61	22.30	1.3	6.2
Dryland grain sorghum	27.29	27.23	19.2	.2

Table 2. (continued).

Crop	Variability index Total	Random	Mean yield[b]	1975-76 proportion of acreage
		Brown (North)		
Irrigated corn	20.92	4.17	90.2	73.3
Irrigated alfalfa	20.00	7.50	3.2	6.0
Dryland corn	26.96	13.15	25.7	3.6
Irrigated grain sorghum	27.81	18.84	68.6	.6
Dryland alfalfa	27.85	20.00	1.4	14.3
Dryland grain sorghum	26.90	21.33	26.2	.8
Wheat	33.55	26.44	23.9	.3
Oats	26.60	26.60	32.1	1.0
		Butler (East)		
	---------percent---------			(percent)
Irrigated corn	15.96	7.60	100.1	24.1
Dryland alfalfa	11.42	7.85	2.8	4.8
Irrigated soybeans	8.13	8.13	34.3	1.2
Irrigated alfalfa	12.05	8.20	3.9	.2
Irrigated grain sorghum	15.79	10.78	81.6	.8
Oats	26.17	13.18	41.8	5.3
Dryland soybeans	18.26	13.46	25.4	10.6
Dryland grain sorghum	21.19	21.19	62.1	23.5
Wheat	24.54	22.87	33.7	12.7
Dryland corn	33.91	24.88	54.7	16.9
		Kearney (South)		
Irrigated corn	19.33	4.70	102.9	59.5
Irrigated soybeans	8.46	7.02	32.6	.1
Irrigated alfalfa	14.10	7.17	3.9	1.5
Irrigated grain sorghum	14.29	9.43	82.9	1.4
Wheat	28.69	14.78	29.9	18.5
Dryland alfalfa	20.80	14.80	2.5	3.6
Oats	22.13	16.80	39.8	.5
Dryland corn	28.88	17.40	40.5	3.8
Dryland grain sorghum	28.05	17.61	52.4	10.8
Dryland soybeans	24.57	20.56	21.4	.3

Table 2. (continued).

Crop	Variability index Total	Random	Mean yield[b]	1975-76 proportion of acreage
Lincoln (Southwest)				
	---------percent---------			(percent)
Irrigated corn	18.70	3.76	96.2	37.3
Irrigated alfalfa	11.08	8.91	3.7	8.4
Dryland alfalfa	16.00	12.00	2.0	15.1
Irrigated grain sorghum	18.73	15.53	68.7	.6
Wheat	25.03	15.78	28.2	27.0
Oats	18.44	18.44	32.7	.9
Dryland corn	39.28	20.53	27.9	9.2
Dryland grain sorghum	27.64	27.64	28.0	1.6
Thayer (Southeast)				
Irrigated corn	16.82	6.26	101.7	24.3
Irrigated grain sorghum	15.44	11.25	86.0	.4
Irrigated alfalfa	11.95	11.70	4.1	7.6
Wheat	25.19	12.30	30.4	30.0
Dryland soybeans	20.85	13.61	19.9	.8
Dryland grain sorghum	25.35	18.17	52.7	4.6
Dryland corn	35.02	21.34	40.2	.8
Dryland alfalfa	21.66	21.66	2.4	30.3
Oats	27.37	27.37	36.6	1.3

[a] 1951-76 for alfalfa, corn, oats, and wheat. 1957-76 for grain sorghum and soybeans.

[b] All crops but alfalfa are in bushels per acre. Alfalfa is tons per acre.

random yield variability indexes lower than nonirrigated crops. In Morrill, Brown, and Lincoln Counties, irrigated grain sorghum yields showed a higher random variability than one or more dryland crops. In Sherman County, irrigated soybeans had a greater random fluctuation than dryland alfalfa and corn. Finally, in Butler County, dryland alfalfa yields showed lower random variability than three of the irrigated crops.

Individual crops with the most stable yields were irrigated corn in six counties and irrigated alfalfa in the remaining counties. The crops showing the greatest yield variability were oats in three counties; dryland grain sorghum in two counties and winter wheat, dryland corn, and dryland soybeans, each in one county. In a few cases the total random yield variability indexes were identical, indicating that all of the yield variability was random.

Among irrigated crops, no particularly strong regional patterns existed. Irrigated grain sorghum variability tended to be relatively high in the North and Northwest areas. Irrigated soybeans exhibited a low yield variability in Eastern Nebraska. Generally, however, irrigated corn and alfalfa had the lowest levels of yield variability among irrigated crops, considering all areas.

Among dryland crops, alfalfa and corn generally exhibited the lowest yield variability while oats and grain sorghum tended to have the highest yield variability. Winter wheat variability tended to be relatively low in Southern, Northwestern, Southwestern, and Southeastern Nebraska.

Yield variability results must be interpreted with caution for those crops with small acreages. Less confidence can be placed in data for those crops with very small acreages. For this reason the average percentage listed was for all crops analyzed in the county. Not all crops historically grown are included in the analysis. Some minor crops have been deleted. For any crop which fails to total 1% of a county total, other areas must be examined before reaching firm conclusions. For example, irrigated soybean acreage fails to exceed 1.5% of crop acreage in four areas. However, the relative variability of irrigated soybeans among the four areas appears quite stable with it being a relatively low risk crop.

In general, it is difficult to discern differences among areas with respect to yield variability. Yield variability in a general sense tends not to be higher for groups of crops in one area relative to another.

In summary, results in Table 2 indicate that irrigation lead to greater yield stability for the period and counties analyzed as compared to dryland yields. Some variation was found in the relative position of the various crops among the counties, but the overall pattern could be described as quite homogeneous.

Net Income Variability

Table 3 presents the total and random variability indexes of net returns per acre for selected field crops in the eight Nebraska counties. Here, as in Table 2, the indexes are ranked according to increasing magnitudes of the random variability indexes.

The net income random variability indexes ranged from a low of 8.83% for irrigated corn in Lincoln County to a high of 14,200% for dryland alfalfa in Morrill County. Compared to yield variability there was a much less consistent pattern in the rankings of net income random variability among irrigated and dryland crops. In spite of heterogeneity, irrigated corn showed the lowest degree of random net return variability in all eight counties.

Table 3. Total and random variability indexes of real (1967 dollars) net returns per acre for selected field crops in eight Nebraska counties.[a/]

Crop	Variability index: Total	Variability index: Random	Mean net returns $
	------------percent------------		
Madison (Northeast)			
Irrigated corn	38.95	16.57	71.54
Irrigated soybeans	37.13	21.65	68.16
Dryland corn	41.93	23.23	46.62
Irrigated alfalfa	71.64	25.84	23.10
Dryland alfalfa	44.45	25.94	27.87
Irrigated grain sorghum	31.52	27.27	43.08
Dryland soybeans	53.89	31.32	44.05
Wheat	63.06	34.11	31.22
Dryland grain sorghum	43.86	43.86	38.07
Oats	83.97	61.04	9.42
Sherman (Central)			
Irrigated corn	35.65	9.79	66.59
Irrigated grain sorghum	22.43	15.21	37.08
Wheat	68.27	26.09	31.62
Irrigated soybeans	39.86	27.90	65.77
Dryland corn	44.18	27.92	24.24
Dryland grain sorghum	37.76	30.27	20.18
Dryland alfalfa	78.13	36.39	11.98
Dryland soybeans	52.25	36.95	32.42
Irrigated alfalfa	81.01	38.39	21.54
Oats	112.70	112.70	4.25
Morrill (Northwest)			
Irrigated corn	41.92	23.58	49.83
Wheat	42.21	24.74	31.77
Dryland corn	85.15	36.95	12.53
Irrigated grain sorghum	42.83	42.83	25.26
Irrigated alfalfa	121.39	44.04	13.60
Oats	76.94	70.06	7.85
Dryland grain sorghum	292.00	267.55	2.25
Dryland alfalfa	16,225.00	14,200.00	.04

Table 3. (continued).

Crop	Variability index Total	Random	Mean net returns $
	Brown (North)		
	------------percent------------		
Irrigated corn	46.63	10.97	64.62
Irrigated grain sorghum	48.75	38.51	29.68
Dryland corn	60.28	40.78	14.05
Irrigated alfalfa	163.55	40.99	11.88
Wheat	61.09	41.93	26.04
Dryland grain sorghum	92.56	61.63	9.41
Oats	128.16	128.10	5.61
Dryland alfalfa	293.39	192.99	2.57
	Butler (East)		
Irrigated corn	31.07	16.68	75.26
Dryland alfalfa	34.91	17.76	30.79
Irrigated soybeans	33.34	19.47	71.73
Dryland soybeans	42.07	21.53	52.15
Irrigated grain sorghum	26.53	26.53	42.66
Wheat	49.69	30.03	43.32
Dryland grain sorghum	30.29	30.29	44.93
Irrigated alfalfa	69.53	32.77	23.83
Oats	68.02	37.17	12.51
Dryland corn	42.34	42.34	47.33
	Kearney (South)		
Irrigated corn	39.38	9.07	79.53
Irrigated soybeans	30.00	12.69	66.89
Irrigated grain sorghum	20.43	17.62	44.19
Wheat	50.16	24.42	35.90
Dryland grain sorghum	37.89	26.99	34.89
Dryland corn	49.81	30.69	31.96
Dryland alfalfa	68.98	31.54	26.12
Irrigated alfalfa	89.34	32.15	26.93
Dryland soybeans	44.58	33.49	41.05
Oats	51.22	45.78	10.68

Table 3. (continued).

Crop	Variability index Total	Random	Mean net returns $
Lincoln (Southwest)			
	------------percent	------------	
Irrigated corn	38.10	8.83	71.10
Wheat	46.41	25.46	33.22
Dryland alfalfa	71.28	36.37	16.44
Irrigated grain sorghum	38.73	38.73	29.74
Irrigated alfalfa	86.51	43.18	20.47
Dryland corn	75.66	57.65	16.27
Dryland grain sorghum	76.66	76.66	10.84
Oats	81.26	81.26	5.71
Thayer (Southeast)			
Irrigated corn	31.86	9.02	77.25
Wheat	43.82	19.12	36.76
Irrigated grain sorghum	21.61	21.60	47.48
Dryland corn	47.26	24.54	30.64
Dryland soybeans	53.69	25.75	37.86
Dryland grain sorghum	40.44	36.81	36.07
Irrigated alfalfa	64.92	42.19	28.51
Dryland alfalfa	63.16	50.23	23.51
Oats	77.62	77.62	8.58

[a] 1951-76 for alfalfa, corn, oats, and wheat. 1957-76 for grain sorghum and soybeans.

Crops showing the greatest level of net income variability were oats in five counties, dryland alfalfa in two counties and dryland corn in the remaining county. In Sherman and Thayer Counties oats had the highest yield and net return variability index. This similarity was also observed for dryland corn in Butler County.

Among irrigated crops, grain sorghum was corn's closest competition for low net return variability in five counties, with soybeans in the other three counties. Compared to the yield variability results, irrigated alfalfa dramatically declined in relative ranking when placed on a net return basis.

There appeared to be no consistent pattern to net returns variability between irrigated alfalfa and dryland alfalfa. An exception to this was Butler County where dryland alfalfa exhibited the second lowest variability of both yields and net returns.

Among dryland crops, corn's position showed slight improvement under a net returns analysis compared to the yield analysis. The lowest ranking reached by this crop was third in three counties. Wheat showed a marked improvement in its ranking under a net returns analysis relative to the yield results. This crop had the second lowest random variability of all enterprises in three counties—Morrill, Lincoln, and Thayer.

Risk was greater in the Northwest and Northern areas compared to other study areas. Among the remaining study areas, little overall difference in risk by area could be seen.

In summary, the lowest net return variability was associated with irrigated corn. However, in the remaining rankings much heterogeneity existed among dryland and irrigated crops between areas. In very general terms we concluded that variability under irrigation tended to be lower than under dryland.

Note that for both irrigated and dryland production, higher levels of net returns were generally not accompanied by higher variability. This indicates that for most cases high return crops do not involve a risk sacrifice. This should not be taken to suggest that in addition to selecting low risk enterprises diversification could not be useful in reducing risk. The foundation for diversification as a risk reducing technique lies in the covariance of net returns between alternative crops over time and its role is beyond the scope of this research.

Net returns for all crops in each area are depicted graphically in Appendix 2.

LIMITATIONS OF STUDY

A major limitation of this study could be attributed to the data used. Data derived from aggregates (such as county or state time series data), tend to underestimate individual farm variation due to an averaging out resulting from aggregation (Eisgruber and Schuman). However, others contend that variability measures derived from historical yields at the farm level "may overestimate the true variability" (Carter and Dean, 1960, p. 178).

The potential shortcoming resulting from aggregate data is recognized but could not be avoided considering the available information. Nevertheless, data in this paper are expected to furnish reasonable relative estimates of the random and total variability indexes for prices, yields, and real net returns. The figures reported for the variability indexes are only approximations, but the relative levels or rankings among the various enterprises are expected to be representative of the true relationships.

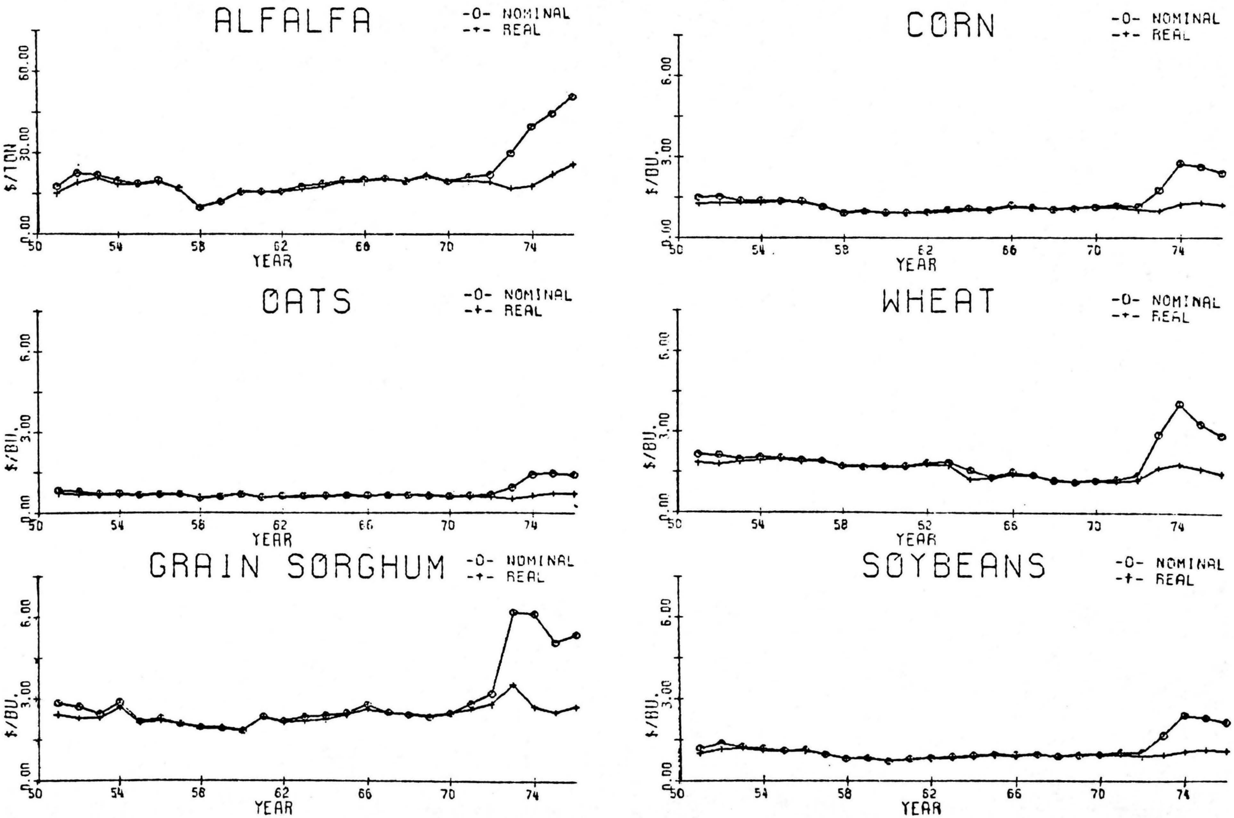
Again, the analysis was performed on harvested acreages rather than planted acreages. Thus, it may well be that this procedure understates the variability of minor dryland crops where acreages are abandoned and not harvested in some years. Also, it should be mentioned that soils are not homogeneous across all crops. It may be expected that irrigated soils tend to be generally more productive compared to dryland soils. Further, among dryland crops some crops may tend to be grown on certain soils.

A word of caution is necessary regarding estimation of the net income random variability index using the variate difference method. This technique "can never completely eliminate the systematic components from the error terms" of an income (gross or net) time series. "Consequently (this) method provides only an approximation to the random variance...income" (Carter and Dean, 1960, p. 218). This might help explain why the net return random variability often represents 100% of total variability, and also why the net income variability indexes are in every case much larger than the yield variability indexes.

APPENDIX 1

NOMINAL AND REAL* PRICES RECEIVED BY NEBRASKA FARMERS FOR SELECTED CROPS

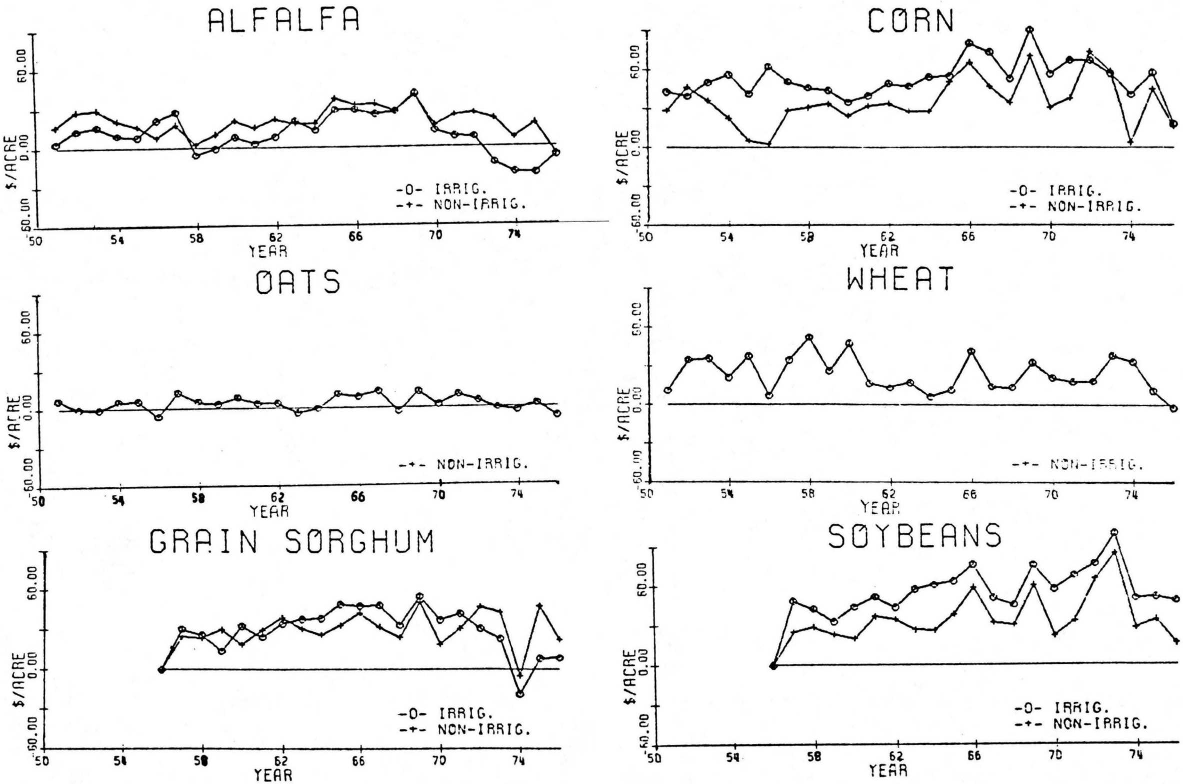
*REAL PRICES: 1967 = Base



REAL* NET RETURNS
FOR SELECTED CROPS IN
MADISON COUNTY

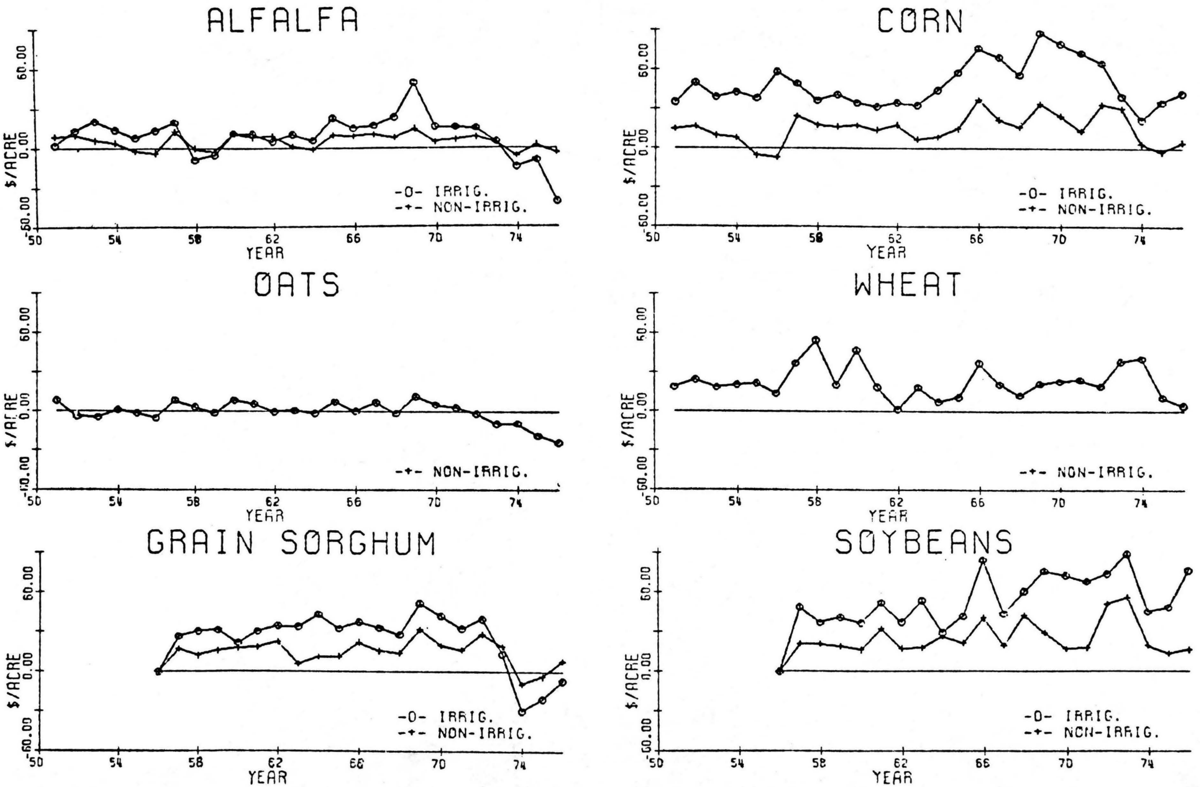
*REAL PRICES: 1967 =Base

APPENDIX 2



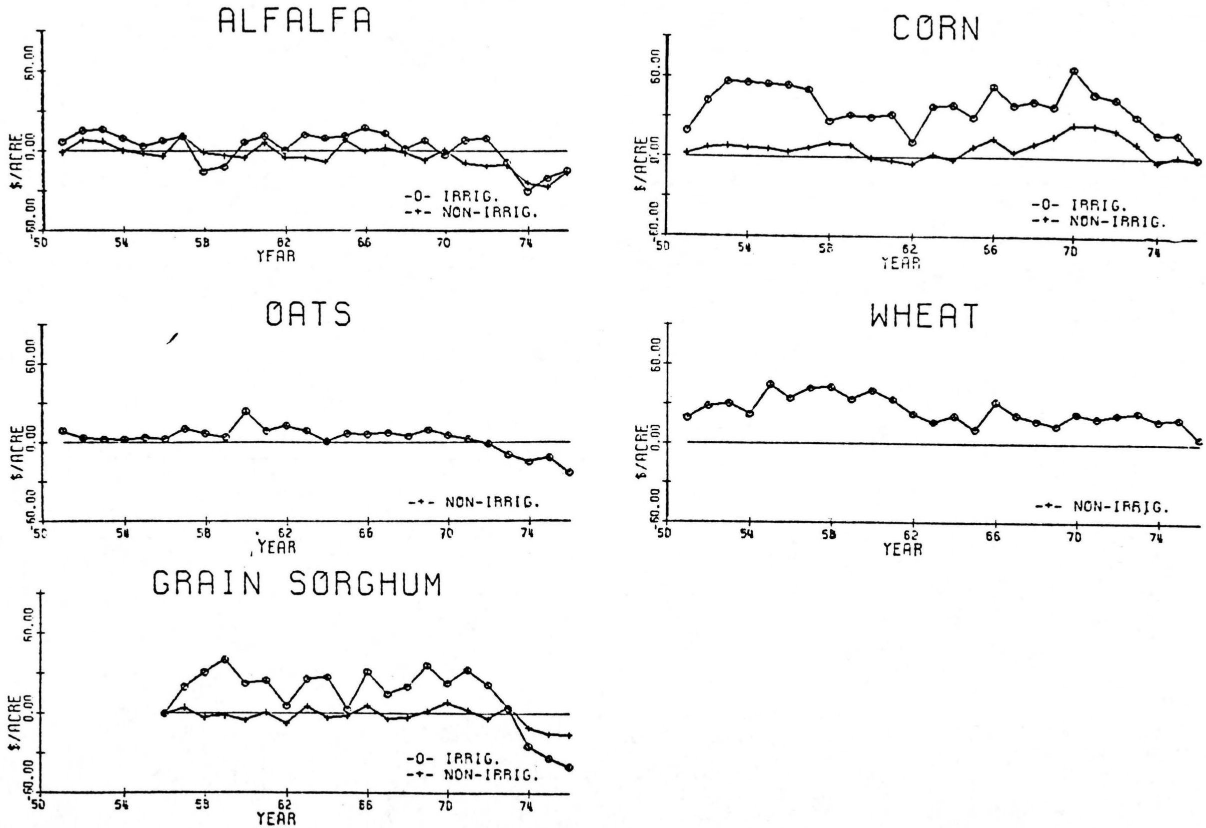
REAL* NET RETURNS
FOR SELECTED CROPS IN
SHERMAN COUNTY

*REAL PRICES: 1967 = Base



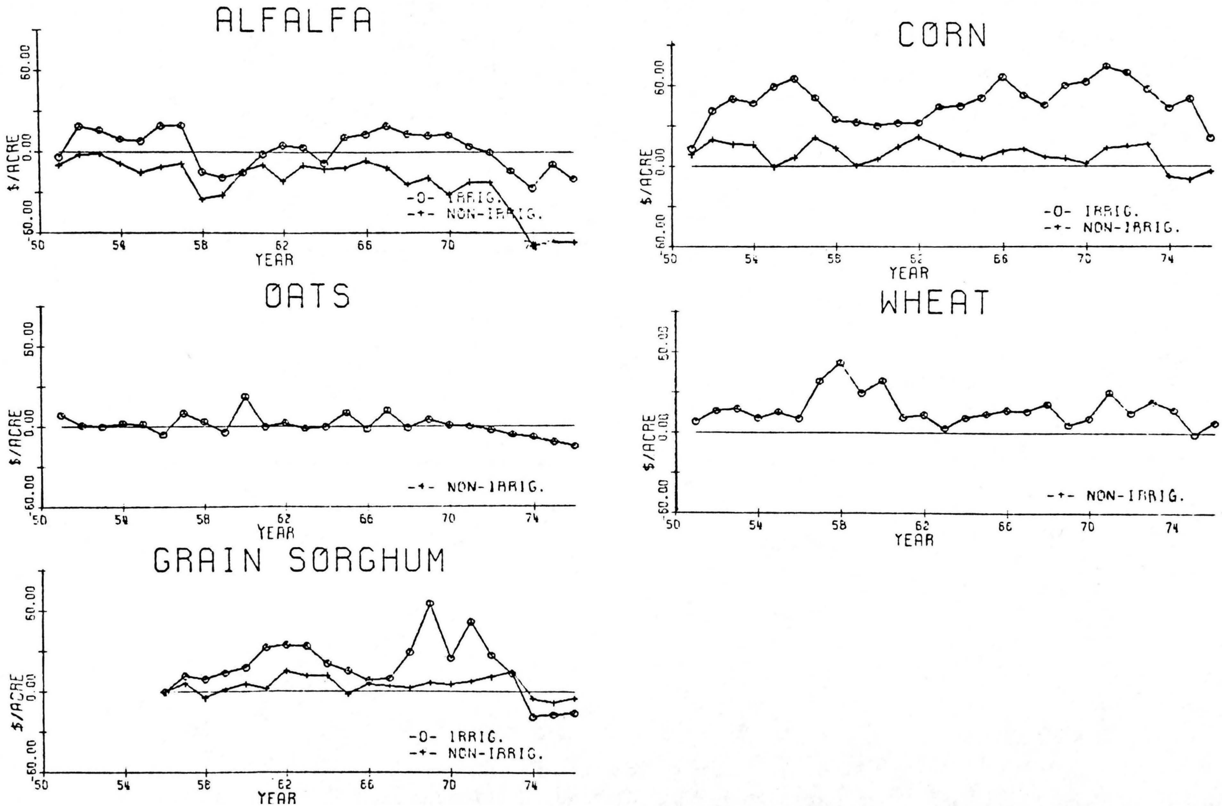
REAL NET RETURNS
FOR SELECTED CROPS IN
MORRILL COUNTY

*REAL PRICES: 1967 = Base



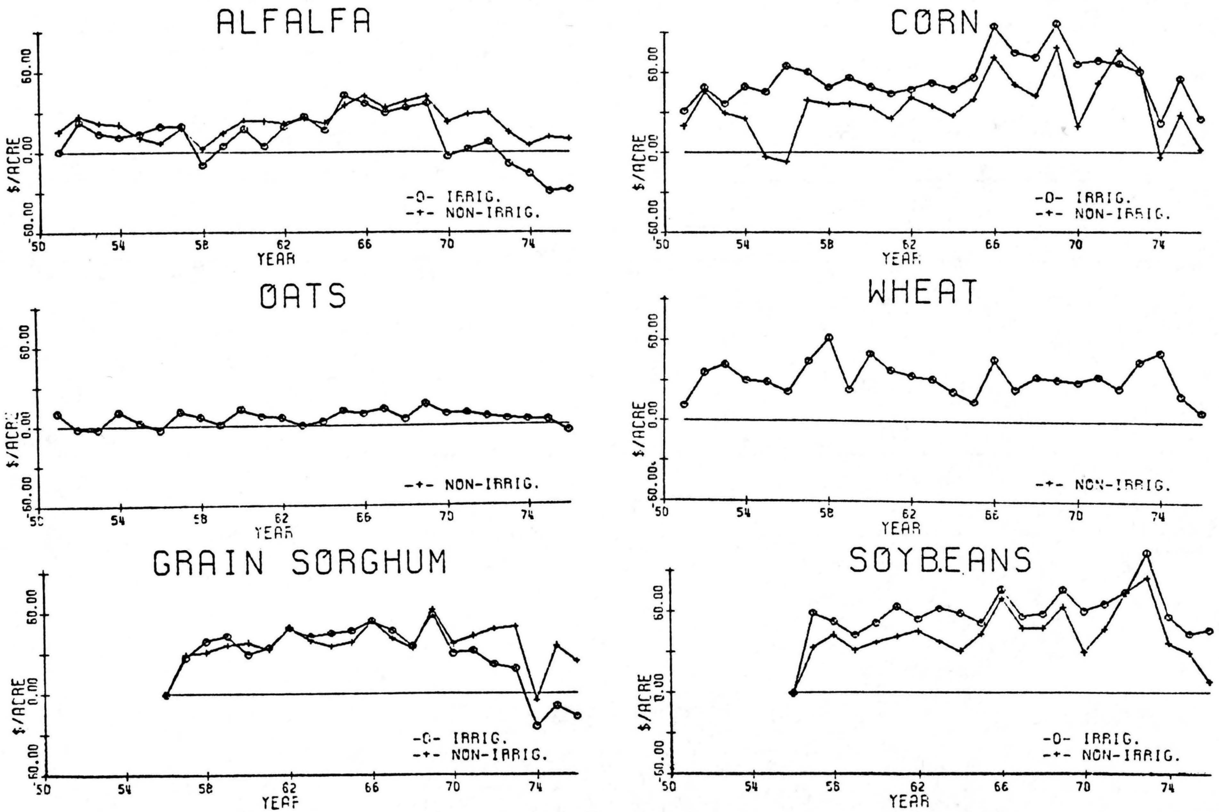
REAL* NET RETURNS
FOR SELECTED CROPS IN
BROWN COUNTY

*REAL PRICES: 1967 = Base



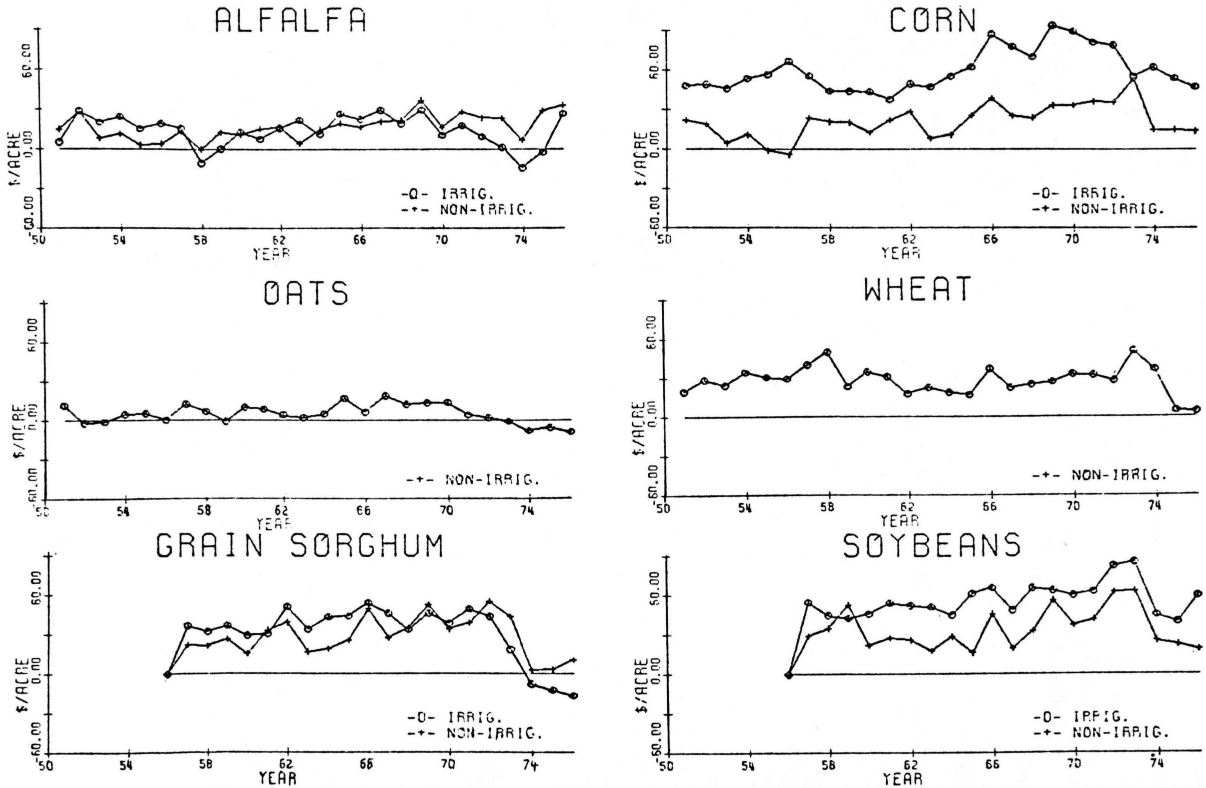
REAL NET RETURNS
FOR SELECTED CROPS IN
BUTLER COUNTY

*REAL PRICES: 1967 = Base



REAL* NET RETURNS
FOR SELECTED CROPS IN
KEARNEY COUNTY

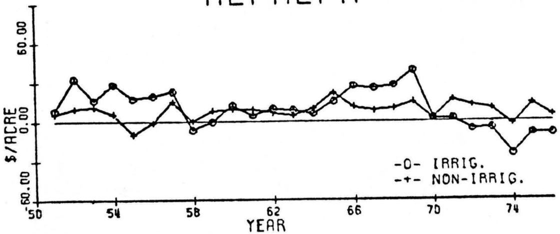
*REAL PRICES: 1967 = Base



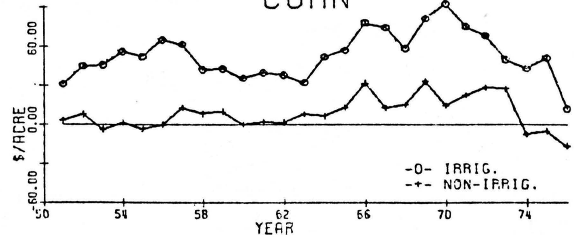
REAL NET RETURNS
FOR SELECTED CROPS IN
LINCOLN COUNTY

*REAL PRICES: 1967 = Base

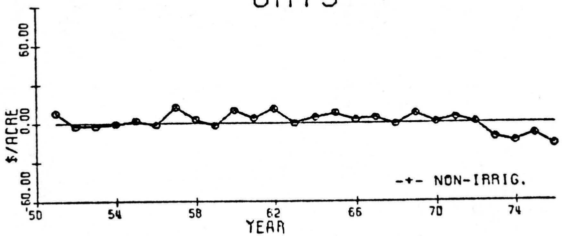
ALFALFA



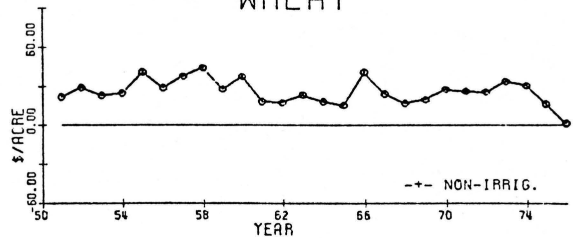
CORN



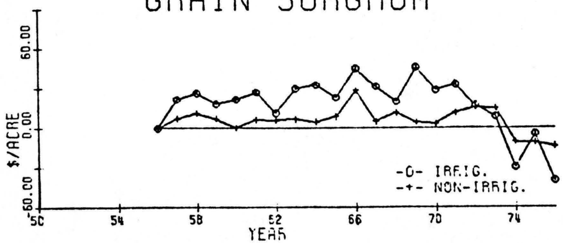
OATS



WHEAT

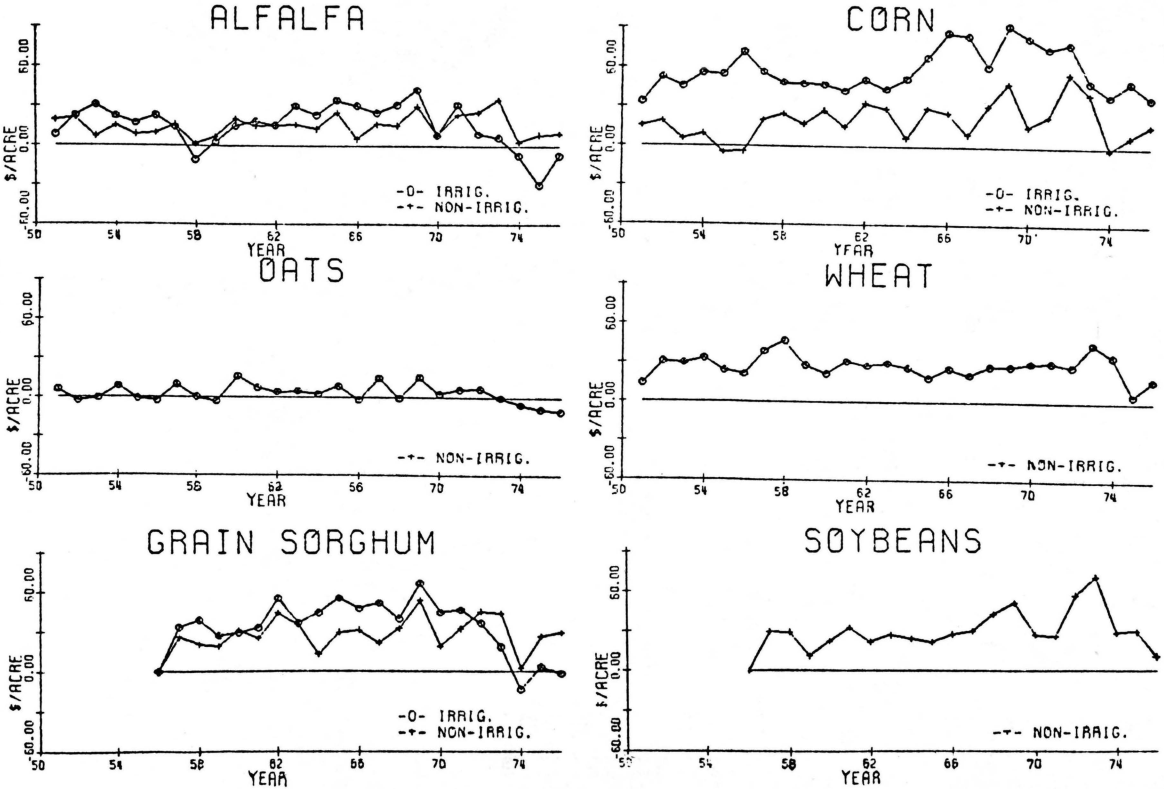


GRAIN SORGHUM



REAL* NET RETURNS
FOR SELECTED CROPS IN
THAYER COUNTY

*REAL PRICES: 1967 = Base



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