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Performance Factors and Management Practices Related to Earnings of East Central North Dakota Crop Farms

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Preface

This publication is part of a research study supported by a grant to the Agricultural Experiment Station at North Dakota State University by the Rural Rehabilitation Corporation of North Dakota. The report presents an analysis of performance factors and management practices related to earnings of East Central North Dakota crop farmers. A companion report, Agricultural Economics Report No. 223 presents an analysis of performance factors influencing economic success of North Dakota crop, beef, and dairy farms.

The authors with to thank the late Mr. Les Gullickson, FBM coordinator, for providing farm records data; Drs. William C. Nelson, Cole R. Gustafson, and David L. Watt for their review; and Mary Altepeter for typing this manuscript. Finally, our thanks go to 28 farmers and their adult Vo-Ag instructors who cooperated in this research.

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Highlights

The objective of this study was to identify farm management measures that explain variation in returns to operator labor and management. Farm record summary data were used to identify factors related to returns. Interview data from farmers with record summaries were used to determine management practices related to factors associated with returns.

Comparison between high and low return farms and correlation and regression analyses were used to analyze the farm record and interview data. The comparative data identified relationships between operator's labor earnings and crop production, machinery, marketing, and financial factors. Additional comparisons were used to identify relations between farming and financial practices used and crop yields, machinery costs per tillable acre, crop marketing index, and weighted cost of capital.

Results indicated that total operator assets, machinery cost control, government payments, crop expenses, crop productivity, and labor efficiency were significantly correlated to operator labor earnings. Total operator assets and machinery costs with crop yield index interaction were the two factors explaining the most variation in operator labor earnings.

The analysis identified the following farming and financial practices to be significant: (1) more nitrogen fertilizer was used in high yield wheat and barley farms, (2) high machinery cost farms had large investments in tractors and implements and used smaller horsepower tractors more intensively, (3) high marketing index farms sold commodities before the end of the calendar year, and (4) high return farms controlled a greater share of land with crop share leases.

PERFORMANCE FACTORS AND MANAGEMENT PRACTICES RELATED TO EARNINGS OF EAST CENTRAL NORTH DAKOTA CROP FARMS

Mark A. Wood, Roger G. Johnson, and Mir B. Ali*

The first half of the 1980s has given the family farm some of its most serious challenges in the post-depression era. Declining asset values, low market prices, and high "real" cost of capital have brought profits down to an often negative level for farmers. Yet, during this same period, the diversity of farm prosperity has seldom been as extreme. Very profitable operations exist alongside bankrupt ones.

Study Objectives

The overall research objective was to identify reasons for the farm income disparity. Specific objectives are:

1. To identify factors of size, efficiency, resource organization, cost control, and marketing that explain variation in operator return to labor and management.

2. To compare selected crop production, machinery management, marketing, and financial practices of farmers with high and low achievement levels of factors identified in objective 1.

3. To explain variation in farmers' returns and achievement of crop production, machinery management, marketing, and resource acquisition factors utilizing correlation statistics and regression analysis.

Data Sources and Study Area

The primary source of data for the factor-return analysis were the annual record summaries for 1982, 1983, and 1984 of the North Dakota Vocational Agriculture Farm Business Management program (NDVAFBM). Additional information was obtained through personal interviews with 28 farmers in the NDVAFBM system to establish detailed production, machinery, marketing, and financial practices used in 1984. The study was confined to cash grain farms in the East Central Region of North Dakota (Figure 1).

Screening criteria were established to reduce extraneous data variability. A total of 52 farms in the East Central Region met the following criteria:

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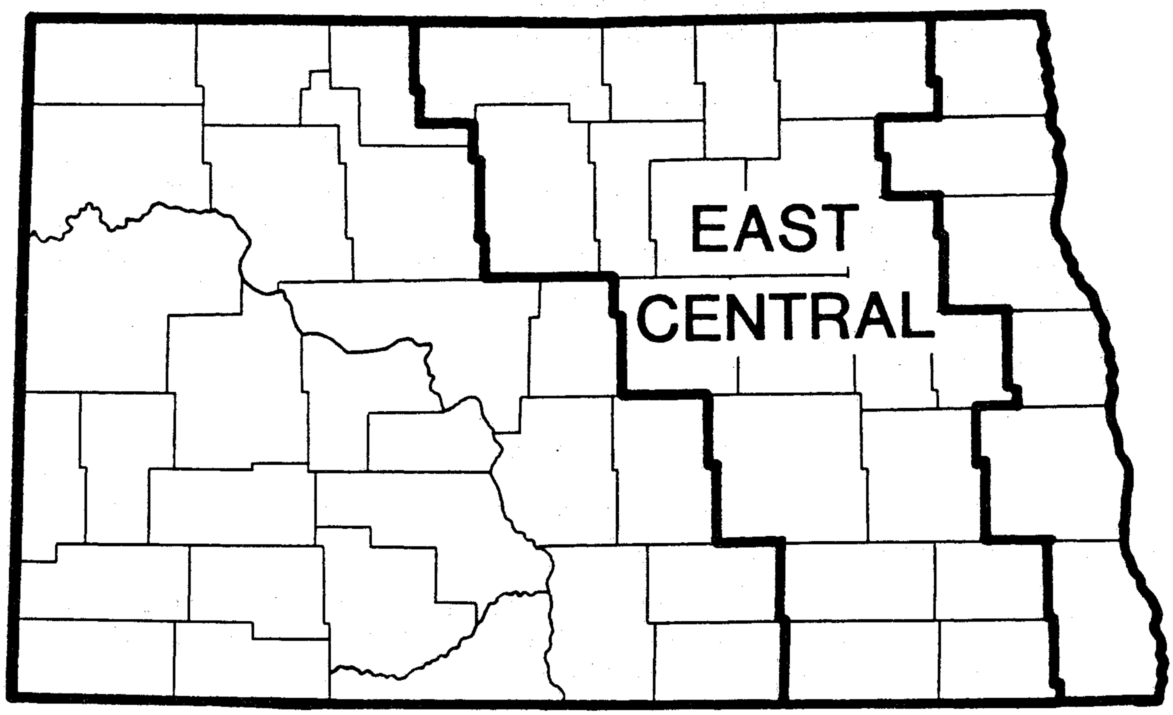

Figure 1. East Central Region of North Dakota

1. Records were available for 1982, 1983, and 1984.

2. Cash receipts were consistent with cash outlays.

3. Size of farm operation did not vary excessively over the three years studied. Tillable acres were not allowed to change more than 35 percent from the previous year.

4. More than 75 percent of cash income was from crops.

An average of three years' records was used to minimize variation of dependent and independent variables. Averaging record data for three years reduces the effect of weather and other chance events influencing production, such as disease, and reduces the effect of inventory measurement errors either in quantity or valuation. Three-year average data were influenced by only the beginning 1982 and ending 1984 inventory values instead of exposure to each year's beginning and ending inventory values.

Twenty-eight of the 52 farmers meeting the screening criteria agreed to participate in an on-the-farm interview. The interviews were to obtain information on crop production practices, marketing practices, resource acquisition procedures, and personal data.

Methods

The analysis combines factor analysis similar to the work of Kleene (1977) and Sexhus (1968) with detailed production practices similar to Held (1973) and Barrios (1978). The analysis was carried out in a two-step process. The first step was the analysis of factors obtained from farm records and interview data explaining variation in operator return to labor and management. The second step measured the effect of practices obtained in the interview on selected factors influencing operator return to labor and management. Figure 2 provides an overview of the analysis process. Also shown are linkages which exist among labor earnings, factors, and practices.

Factors calculated to explain variation in earnings were crop yield index, marketing index, machinery cost per acre, and a variety of additional financial and cost-control variables. The dependent variable was operator return to labor and management (also referred to as labor earnings). Return to labor and management was used for this analysis because it attempts to calculate returns on a comparable basis for farms of different structure and size. Return to labor and management is the residual after all costs except operator labor and management are subtracted from adjusted gross receipts. Adjusted gross receipts are gross receipts adjusted for inventory changes.

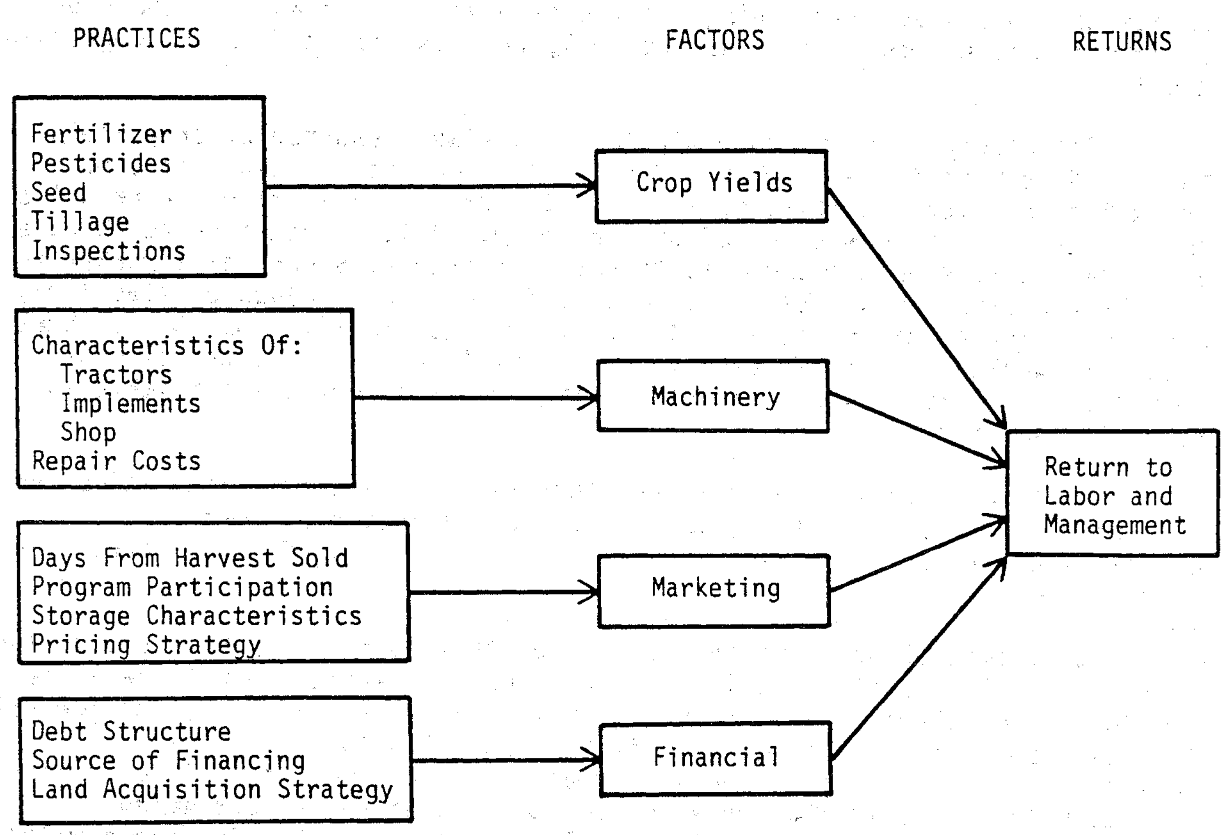

Figure 2. Schematic Diagram of the Analysis Process

All costs include operating expenses, depreciation, and opportunity charges for owned capital. Owned capital was categorized as real estate and nonreal estate capital. Nonreal estate capital was charged 12 percent opportunity cost and real estate capital was charged cash rent. The ownership charges were made only on net worth of the asset. Interest paid and land rental costs were the appropriate fees for the nonowned resources used.

The mean value of operator returns to labor and management for 1982, 1983, and 1984 was used to reduce variation due to weather and other single year phenomenon. Farmers with consistently high or low levels of return to labor and management for the three years were assumed to have strong or weak management performance, respectively.

Independent variables were also averaged for 1982, 1983, and 1984. The independent variables were organized into five categories. These categories were: (1) size, (2) efficiency of labor and production, (3) resource organization, (4) cost control variables, and (5) level of marketing proficiency and use of government programs.

Size of farm is measured by several variables: total operator assets, total acres, tillable acres, work units, and total cash receipts. Tillable acres, total operator assets, and work units were included in the stepwise selection process for developing a regression model. Because of the high intercorrelation among size measures, only one was included in the regression model.

Efficiency of crop production and labor was measured by crop yield index and work units per worker. Crop yield index is a measure of crop production per acre in relation to the relevant county average. Work units are a measure of farm size based on the amount of labor required to operate the farm. A work unit represents the average accomplishment of a worker in one 10-hour day. Work unit values are assigned to each class of livestock, each crop, and to other tasks utilizing farm labor (Gullickson 1984). Work units per worker are an efficiency measure of labor, i.e., total size of operation in terms of labor divided by the number of workers available to complete the work.

Resource organization measures consisted of debt-to-asset ratios for the operation, chattel, real estate, and overall debt structure. Land acquisition strategy reviewed the structure of acres owned, share rented, and cash rented.

Cost control measures the ability of farmers to hold their production costs down. The specific variables were overhead expenses per tillable acre (includes farm share of expenditures for telephone, electricity, and general farm expenses); crop expenses per tillable acre (includes fertilizer, pesticides, and other crop expenses); machinery cost per tillable acre (includes fuel, lubricants, repairs, custom work hired and estimated depreciation); and weighted cost of capital (interest actually paid divided by total farmer debt).

Marketing proficiency was measured by a marketing index which compares prices received for crops adjusted for storage costs. Government payments per tillable acre are classified under marketing because government program participation tends to establish the prices received for the major crops.

The second step was to analyze the management practices for four factor categories. The factors were crop yields, machinery, marketing, and finance.

Crop production factors influencing yields included seed yield potential index, total nitrogen available, days to complete planting, percent of acres treated with chemicals, days to finish harvesting, annual and critical precipitation, and tillage intensity.

Machinery management factors to lower machine costs and repair costs per tillable acre included shop size, building type, percent concrete floor, equipment, custom harvest expenses, depreciation, average age of tractors and combines, total annual hours of use for tractors and combines, and percent of labor in repair expenses.

Factors for effective marketing included percent of grain stored commercially or on the farm during harvest, percent of crop forward contracted or hedged, weighted average days from harvesting until a specific crop is sold, protein potential index (wheat only), percent annual production storable on farm, and use of charts and hired marketing services.

Finance practices influencing low-cost resource acquisition included average years from land purchase; average purchase price per acre; and percent of real estate financed by private, subsidized, and commercial lenders.

Characteristics for high, low, and average levels of the dependent variable are compared. The high and low categories are observations in the top and bottom 25 percentile levels of dependent variables. The average of all observations gives a bench mark for comparing the more extreme groups.

Most of the variables used in the tabular comparison were also analyzed using correlation and regression procedures. Explanatory models were developed based upon hypothesized relationships and statistical tests. The regression analysis was used to identify (1) significance of variables (t-test), (2) the amount of variation in the dependent variable explained (R-square), and (3) the percent of the variation in the dependent variable explained by an individual independent variable when all other variables were held constant (partial R-square).

Factor-Return Comparisons

Operator return to labor and management is the measure of earnings used for this analysis. As background, other measures of income are presented in Table 1. Cash receipts, cash expenses, net cash income, and net farm income are used to identify financial characteristics of the farms studied. Net cash income is simply the cash receipts minus the cash expenses. Both return to labor and management and net farm income accounted for inventory adjustments. The difference between net farm income and operator return to labor and management is the deduction of opportunity cost of owned capital in the calculation of return to labor and management. Total and tillable acres are also included in Table 1 to give a perspective of operation size for the three return to labor and management categories. Compared with net cash income and net farm income, return to labor and management has more variability. Low return farmers had net cash incomes 65 percent of that of the high return farmers. The income picture changed markedly when inventories were considered. Low return farmers had only 8 percent of the net farm income of high return farmers. The predominant factor involved in low net income farmers was inventory value changes. Low income farmers are often forced to reduce inventories to meet cash needs.

The range of operator return to labor and management extended well below net farm income. In addition to inventory adjustments, operator labor earnings included an opportunity cost of owned capital. Low return farmers owned more land which was charged an opportunity cost.

Cash receipts, cash expenses, government payments, and interest payments are presented in Table 2. All values are shown in dollars per tillable acre to minimize the influence of size. Mean tillable acres are included so the relative size of the operations in each category of operator return can be considered.

TABLE 1. AVERAGE FARM INCOME AND EXPENSES COMPARED TO SELECTED LEVELS OF OPERATOR RETURN TO LABOR AND MANAGEMENT

	Return to Labor and Management		
Income Measures	Low 25%	All Farms	High 25%
	dollars		
Cash receipts	130,241	116,847	106,453
Cash expenses	106,431	87,281	69,883
Net cash income	23,810	29,566	36,570
Inventory change including depreciation	-21,379	-13,850	-6,990
Net farm income	2,431	15,716	29,580
Opportunity cost of owned resources	36,480	22,791	14,435
Return to labor and management	-34,049	-7,075	15,145
Total acres	1,638	1,447	979
Tillable acres	1,310	1,087	833

TABLE 2. AVERAGE CASH RECEIPT AND CASH EXPENSE PER ACRE OF FARMS ANALYZED BY RETURN CATEGORIES

Income Attributes	Return to Labor and Management		
	Low 25%	All Farms	High 25%
	-----dollars/per tillable acre---		
Cash receipts	99.42	107.49	127.79
Cash expenses	81.24	80.30	83.89
Net cash income	18.18	27.19	43.90
Government payments	7.87	10.90	13.30
Interest paid	16.29	16.76	19.32
Tillable acres	1,310	1,087	833

High return farmers on average had $25.72 more net cash income per acre than did the low return farmers. The higher receipts were accomplished with only slightly higher cash expenses per acre. Part of the cash receipt difference was due to government program payments. The low return farmers were considerably short of the subsidy level for mean and high return farmers. The data indicated that generating high cash receipts was more important than control of cash expenses.

High return farmers were carrying the highest debt and interest payments per tillable acre, yet had sufficient earnings to offset the cost of their debt. This would seem to indicate an efficiency inherent among high return farmers; they must be efficient to keep up with debt requirements.

The various measures of size are summarized in Table 3. Size was associated with low returns to labor and management for all farm size measures shown. Apparently size by itself is not sufficient to assure high returns. The high return farmers had higher profit margins on a lower volume of production. Efficiency and cost control are more critical than size, especially in times when profit margins are frequently negative.

Two measures of efficiency--crop yield index and work units per worker--were studied. The levels of these measures in relation to operator return are presented in Table 4.

Crop yield index and work units per worker had a positive influence on operator return to labor and management. Crop yield index is a measure of the productivity of cropping enterprises compared with the county average. Crop productivity is related to several aspects of the farm operation. A few are

TABLE 3. AVERAGE MEASURES OF SIZE AS COMPARED TO SPECIFIED LEVELS OF RETURN TO LABOR AND MANAGEMENT

Size Measures	Return to Labor and Management Low 25%	All Farms	High 25%
Tillable acres[a]	1,310	1,087	833
Total acres	1,638	1,447	979
Total cash receipts	$130,241	$116,847	$106,453
Work units[a]	454	403	320
Total operator assets[a]	$679,587	$483,992	$368,414
Number of workers	1.8	1.44	1.13

[a]Independent variables used to measure size in the stepwise regression procedure.

the land quality (i.e., fertility, topography, and soil type), level of fertilizer and other inputs applied, and more subtle management aspects such as timeliness. Labor utilization (as measured by work units per worker) was better for high return farmers than low return farmers. This is a reflection of more intensive cropping with use of less labor.

Resource organization can be measured by many methods. Table 5 indicates some resource organization measures. High return farmers not only farmed less tillable acres, they also owned on average only 36.5 percent of their tillable acres compared with an average of 58 percent for the low return farmers.

Rental acreage dominated the high return farmers' land complement. Also, high return farmers share rent over twice the number of acres they cash

TABLE 4. AVERAGE MEASURES OF CROP YIELD INDEX AND WORK UNITS PER WORKER AS COMPARED TO LEVELS OF RETURN TO LABOR AND MANAGEMENT

Efficiency Measures	Return to Labor and Management Low 25%	All Farms	High 25%
Crop yield index	98.3	100.2	107.0
Work units per worker	252.2	279.9	283.2

TABLE 5. AVERAGE MEASURES OF RESOURCE ORGANIZATION AS COMPARED TO SPECIFIED LEVELS OF RETURN TO LABOR AND MANAGEMENT

Measures	Return to Labor and Management		
	Low 25%	All Farms	High 25%
Tillable acres	1,310	1,087	833
Owned acres	768	500	305
Share rented acres	251	276	357
Cash rented acres	291	311	171
Rental rates			
Landlord share (%)	33	37	42
Cash rent	$27.32	$32.36	$38.75
Total operator assets	$679,587	$483,992	$368,414
Debt-to-asset ratio	.27	.39	.52
Capital cost (%)	11.63	9.65	8.40

rent. Share and cash rent acreages were nearly equal for the low return farmers. These increased acres of share rented land do not come without a price. High return farmers averaged 42 percent more rent per acre than low return farmers. High return farmers rented land on a landlord-tenant share basis, an average of 42 percent compared with 33 percent for low return farmers. This additional landlord share may be offset by more productive land or other inputs provided by the landlord.

The debt-to-asset ratios indicated the high return group of farmers to be highly leveraged. The generally low earnings of agriculture the past few years have caused highly leveraged farmers to be at financial risk. The highly leveraged farmers had the lowest weighted cost of capital of the group at only 8.4 percent. This would indicate that recent borrowings for land, machinery, and operating capital are from subsidized interest rate sources such as Farmers Home Administration or relatives. Since the capital of high return farmers was obtained at a lower cost than that charged for opportunity cost on owned capital, farmers with high debt had lower interest charges.

The cost control factors were overhead expenses, crop production expenses, and machinery cost per tillable acre. These factors are summarized for the low, high, and mean return group of farmers in Table 6.

Overhead expense per acre was lower for both low and high return farmers than the all farmer mean. This does not indicate a strong relationship between operator return and overhead expenses per acre. Crop

TABLE 6. AVERAGE MEASURES OF EXPENSES OF FARMERS AS COMPARED TO SPECIFIED LEVELS OF RETURN TO LABOR AND MANAGEMENT

Expense Measures	Return to Labor and Management		
	Low 25%	All Farms	High 25%
	--------------dollars--------------		
Overhead expense per acre	3.57	3.80	3.16
Crop expense per acre	24.22	23.33	26.75
Machinery cost per acre	44.88	38.16	38.09

expense per acre was highest for the high return farmers, but nearly the same for low return and all farmers. The high return farmers had higher crop yields as shown in Table 4. Because high crop yields were related to high crop expenses, a positive relationship between crop expenses and operator return existed.

Machinery costs per acre did not include an opportunity cost for ownership, but did charge an estimated depreciation rate of 20.37 percent of the machine inventory values. Depreciation costs of newer machines explained part of the reason low return farmers had a high machinery cost. Mean machinery value per tillable acre for the low return farmers was $82.50, whereas, the high return farmers had only $65.30 tied up in machinery.

Two measures were used to quantify marketing. The first was an index of prices received for crop commodities, with all carrying costs subtracted, in relation to average price available at harvest. The second measure was total government payments per tillable acre. These included deficiency payments and storage payments for farmer's-stored grain under a resealed loan or in the Farmer Owned Reserve. In most cases the marketing index incorporated the price obtained by procuring a CCC loan on grain, but the deficiency payments were not part of the final price included in the marketing index.

Marketing index and government payments per tillable acre are compared for selected categories of operator return in Table 7. The marketing index did not indicate a strong relationship with operator return to labor and management. The reason that average farmers have a marketing index of 97.3 instead of 100, is that the farmers analyzed did not cover all carrying costs for commodities marketed from 1982 through 1984.

High return farmers on average obtained 69 percent more government payments per tillable acre than low return farmers. The factors influencing government program payments are: (1) level of program participation, (2) level of deficiency payments per acre, and (3) number of program acres, wheat base and feed grain base, relative to tillable acres in the farm.

TABLE 7. AVERAGE MEASURES OF CROP MARKETING INDEX AND GOVERNMENT PAYMENTS PER ACRE AS COMPARED TO SPECIFIED LEVELS OF RETURN TO LABOR AND MANAGEMENT

Marketing Measures	Return to Labor and Management Low 25%	All Farms	High 25%
Crop marketing index	96.19	97.27	97.85
Government payments per tillable acre	$7.87	$10.90	$13.30

Factor-Return Model

All the variables discussed previously were analyzed by correlation and regression statistics. Also, the additional interaction variables of crop yield index and total machine cost, crop yield index and marketing index, and crop yield index and tillable acres were included in the analysis.

The regression coefficients for the variables in the best model are given in the follow equation:

$$Y_1 = -79905 - .039X_1 - 8.92X_2 + 2304X_3 + 673X_4 + 62.01X_5 + 644X_6$$

t-value: (-4.4) (-5.46) (-5.15) (5.2) (3.94) (2.37) (2.37)

Partial R-square: .60 .52 .57 .43 .25 .22

Model R-square = .81 Degrees of freedom = 20

where

Y_1 = returns to labor and management

X_1 = total operator assets

X_2 = crop yield index interaction with machine cost per acre

X_3 = government payments per tillable acre

X_4 = crop yield index

X_5 = work units per worker

X_6 = crop expense per tillable acre

Total operator assets (X_1) was negatively correlated with operator return to labor and management. Part of the larger asset values of low return farmers was from their ownership of more acres than high return farmers (2.5 times the owned acres of high return farmers as shown in Table 5). All categories of assets were larger in value for the low return farmers compared to the high return farmers. Total assets are a combination of machinery, land, and other assets, making total operator assets a measure of size. There are two important aspects of size as measured by total operator assets: (1) farm size, and (2) proportion of land owned by the operator.

The regression coefficient indicated a reduction in return of 3.9 cents for every dollar of increase in assets. The sum of interest paid and calculated opportunity costs equal the total cost of owned and borrowed capital. The average cost of combined owned and borrowed assets was 8.9 percent. Subtracting 3.9 percent from 8.9 percent indicates that the average rate of return on assets is 5 percent for the farms analyzed.

The partial R-square or amount of variation in returns explained by total assets was 60 percent when all other variables are held constant. The high partial R-square indicates that total assets was the most important independent variable in accounting for the variation of operator return.

The crop yield index interaction with machinery cost per acre (X_2) was negatively correlated to operator return to labor and management. The negative sign indicates that increased yields with the employment of additional machinery costs would not be a profitable practice. Machinery costs do not seem to have a great effect on crop production. This is due to the generally adequate machinery capacity on farms in the study. Excess machinery capacity apparently exists for farmers with high yields and control of machinery costs in relation to crop yields is likely to increase the return. The partial R-square for crop yield index interaction with machinery cost per acre explained 52 percent of the variation in returns when all other variables were held constant. This indicates the crop yield index interaction with machinery cost per acre is second only to total assets in explaining labor earnings.

Government payments per tillable acre (X_3) are only a partially controllable management practice. A farmer can participate in the different government programs for the various crops. In some programs there was a choice in the level of participation as was the case with the 1983 PIK program. This model showed for every dollar of increased government payments per tillable acre, returns to labor and management increased by $2,304. The $2,304 increase in return is caused by several factors, some of which are (1) level of participation in the particular program crop, (2) level of proven yields used to calculate deficiency payments, (3) number of established "base" acres of program crops available to the farmer, and (4) amount of storage payments received from resealed CCC grain or the Farmer Owned Reserve.

The benefit of government payments on earnings was greater than the dollar income received. For example, a $1.00 per acre increase in government payments on a 1,087-acre farm would add $1,087 to gross receipts, yet labor earnings increase $2,304 which is $1,217 more than receipts. Two possible reasons for the additional income are reduced production costs from diverted acres and increased cropping intensity on land in production.

Crop yield index (X_4) is positively correlated to operator return. A positive relationship was identified in the descriptive analysis, but it did not appear strong. The regression coefficient shows a $673 increase in returns for every one percent increase in the yield index. Crop production can be influenced by the farm manager to a large extent, but there still exists that element of risk due to weather. The three-year average removes some of the weather-related variation.

Since crop yield index was positive and crop yield index/machinery cost per acre interaction has a negative influence on operator return, the net effect needs to be considered. What would the net effect be if crop yield index increased from 100 to 101 and machine costs per acre were maintained at the $38.16 mean with all other variables in the model held constant?

Positive effect of crop yield index: (673*101)-(673*100) =	$673.00
Negative effect of crop yield and machinery cost per acre interaction: (-8.92*101*38.16)-(-8.92*100*38.16) =	-$340.40
Overall net effect =	$332.60

Increases in machinery cost per acre can be offset by increases in crop yield index. For low return farmers that on average had high machinery cost per acre and a low crop yield index, the objective should be to lower machinery cost per acre and to increase yields from other practices such as increased crop inputs or crop intensity.

Work units per worker (X_5) is a measure of efficiency of labor in the farm operation. One method of increasing work units per worker is to increase the size of the operation. An addition of 3.3 acres of wheat to the farm operation would increase total work units by one. Another method of increasing work units per worker is to increase the intensity of crop production. Small grains require .3 work units of labor per acre. Corn for grain requires .55 work units of labor per acre. A farm manager could increase his total work units one work unit by converting four acres of wheat to corn. If the farm manager can accomplish either of these situations outlined without additional labor, the net effect on operator returns would be an increase of $62.

Crop expense per tillable acre (X_6) was greater for the high income farmers. This model indicates a $644 improvement in return for every additional $1.00 spent per acre on crop expenses. For the average-size farm, a $1.00 increase in crop expenses would increase returns by $1.59.

The partial R-squares suggest close consideration should be given to the influence on returns of total operator assets, crop yield index interaction with machinery cost, and government payments per tillable acre. Crop expense per tillable acre, crop yield index, and work units per worker are still important because they are significant variables in the model, but their relative importance within the model is lower. In other words, a farm manager comparing his operation with this model should be concerned with all six independent variables, but especially with total assets, crop yield index interaction with machinery cost per tillable acre, and government payments per tillable acre. If the farm manager already measures well on the first three variables, then careful consideration of his level of crop expense per tillable acre, crop yield index, and work units per worker could be helpful in identifying possible reasons for less than optimum return to labor and management.

Crop Production Practices

Crop production practices were analyzed for wheat, barley, and sunflower. The 1984 crop yield per acre was used to divide farms into high- and low-yield groups. Practices examined include: (1) seed quality and variety selection, (2) nitrogen fertilizer use, (3) herbicide and insecticide use, (4) tillage trips, (5) timeliness of planting and harvesting, and (6) field inspection.

Wheat and Barley Yields

Nitrogen fertilizer and herbicide use were associated with yield levels of both crops. Barley yield also varied with September through July rainfall. Precipitation was not as influential to wheat yields in part because about one-third of the wheat was planted on summer fallowed land. Seed selection, tillage trips, and timeliness in planting and harvest were not associated with 1984 yields. Measures of nitrogen fertilizer and herbicides used in wheat and barley production are summarized in Table 8.

Wheat yield goal of 47 bu/acre (30 percent above 1984 average yield)[1] was assumed. The recommended quantity of total nitrogen available to achieve the yield goal would be 117 lb/acre (Dahnke, 1985). The average and low wheat yield groups of farmers did not provide the recommended quantity of nitrogen. The high yield farms provided about 120 percent of the recommended nitrogen, and their average yield was 95 percent of the yield goal indicating the influence of other limiting factors on wheat yields. The data indicate the importance of adequate nitrogen, although some farms may not be able to attain the yield goal used.

A barley yield goal of 77 bu/acre was established (30 percent above 1984 average yield). Total nitrogen recommended to produce 77 bushels of malting and feed barley is 115 and 135 lb/acre, respectively (Dahnke 1985). Low barley yield farmers did not provide this much nitrogen. On average, farmers provided nitrogen near the recommended level for malting barley, but less nitrogen than recommended for feed barley. Crop farmers in this region generally attempt to produce malting barley. High yield farms provided 115 percent of recommended total nitrogen for malting and 98 percent for feed barley.

The percentage of acres treated with broadleaf and grass control herbicides shows the relation between crop yields and herbicide practices. Farmers with low wheat and barley yields commonly treated a large proportion of their acres with grass control herbicides. Broadleaf control herbicides were sprayed routinely on all wheat and barley acres, while grass control herbicides were used to control a grass weed problem. Wild oats and foxtail

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[1]A yield goal 30 percent larger than average crop yield is simply a measure useful in comparing fertilizer recommendations and actual use. A farmer chooses a yield goal that is appropriate for his operation.

TABLE 8. AVERAGE MEASURES OF CROP PRODUCTION PRACTICES FOR FARMS WITH HIGH AND LOW WHEAT AND BARLEY YIELDS, 1984

Measures of Crop Production Practice	Crop Yield		
	Low 25 %	All Farms	High 25 %
Wheat:			
Yield (bu/acre)	26.8	36.2	44.7
Percent of acres planted on fallow	27.7	34.5	41.4
Nitrogen applied (lbs/acre)	30.1	31.9	49.6
Total nitrogen available (lbs/acre)[a]	108.9	114.0	142.4
Percent of acres treated with:			
Broadleaf herbicide	138	114	101
Grass herbicide	85	51	57
Barley:			
Yield (bu/acre)	43.9	59.5	76.0
Annual precipitation (inches)	13.9	14.6	16.1
Nitrogen applied (lbs/acre)	32.0	52.0	58.4
Total nitrogen available (lbs/acre)[a]	95.0	117.0	132.6
Percent of acres treated with:			
Broadleaf herbicide	97	102	98
Grass herbicide	82	47	0

[a]Applied nitrogen plus average nitrogen in soil based on 1972-1981 county average soil tests results.

were the principal grass weed problems. Grass control herbicides are not always completely successful and can cause crop injury. The percentage of acres treated with grass control herbicides tended to indicate the degree of grass weed infestation rather than level of grass weed control.

All the above-mentioned variables were included in a regression analysis. The wheat model developed is as follows:

$$Y_1 = 25.18 - .048X_1 + .10X_2$$

t-value: (4.48) (-1.94) (-2.21)

Partial R-square: .16 .13

Model R-square = .24 Degrees of freedom = 25

where

Y_1 = wheat yield (bu/acre)

X_1 = percent of acres treated with non-wild oats specific grass control herbicides

X_2 = total nitrogen available (lbs/acre)

The percent of acres treated with non-wild oats specific grass herbicides is negatively correlated to 1984 wheat yields. The descriptive analysis identified a similar relationship between wheat yield and the percent of acres treated with grass herbicides. The hypothesis of herbicide use reviewed in the descriptive section is reinforced by the regression analysis of wheat yields. If total nitrogen available is held constant, the percent of acres treated with non-wild oats grass control herbicide explains 16 percent of the variation in wheat yields for 1984. As expected, total nitrogen available is positively correlated to wheat yields. When holding all other variables constant, total nitrogen available explains 13 percent of the variation in wheat yields for 1984.

This wheat yield model only explained 24 percent of the variation in yields. Because of the large unexplained variance, caution is advised when using regession coefficients to estimate wheat yield. The model is useful in identifying total nitrogen and percent of acres treated with grass control herbicides as the two most significant variables explaining variation in 1984 wheat yields.

The regression model for barley is as follows:

$$Y_1 = -35.82 + 5.78X_1 + .242X_2 - .05X_3$$

t-value: (-1.70) (4.30) (2.90) (-1.62)

Partial R-square: .53 .34 .13

R-square = .68 Degrees of freedom = 16

where

Y_1 = barley yield (bu/acre)

X_1 = total rainfall (inches/year)

X_2 = applied nitrogen (lbs/acre)

X3 = percent of acres treated with non-wild oats grass control chemicals

Barley yields are positively correlated with total rainfall. This was also identified in the descriptive analysis. The partial R-square indicates that total rainfall explains 53 percent of the variation in barley yields when all other variables are held constant. Applied nitrogen had a positive correlation with barley yield. The positive relationship between barley yield and fertilizer application was also noted in the descriptive analysis. The partial R-square indicates that applied nitrogen explains 34 percent of the observed variation in barley yields when all other variables are held constant.

Percent of acres treated with non-wild oats grass control herbicides is negatively correlated to barley yields. The t-value, however, is not highly significant. The marginal significance was accepted because of the significance of this variable in wheat production. It would seem from both the wheat and barley analyses that when non-wild oats grasses are a problem in small grain production, yields suffer even when treated. The partial R-square indicates that percent of acres treated with non-wild oats grass herbicides accounts for 13 percent of the variation in barley yield when all other variables are held constant. The previous discussion on herbicides identified reasons a negative relationship is likely to exist.

Sunflower Yield

Similar measures of production practices were used in the sunflower analysis. Use of nitrogen, herbicide and insecticide, field inspection, and tillage trips are summarized in Table 9.

Total nitrogen available was adequate for all sunflower yields based on a yield goal 30 percent above 1984 yields. Herbicides used to control grass weeds were routinely applied by all farmers. Insecticide use was heaviest for the low-yield groups. The use of insecticides tended to measure the degree of insect problem, which can adversely affect yield. Farmers in the low-yield group were making an effort to control recognized production-limiting situations by increasing the frequency of inspections and insecticide applications.

Farmers in the high-yield group used more shallow tillage trips. Two possible strategies would require more shallow tillage, (1) later planting in the spring and (2) row-crop cultivating once or twice during the summer.

The regression model developed for the sunflower production is as follows:

$$Y_1 = 532 + 97.62X_1 + 93.22X_2$$

t-value: (4.19) (2.19) (3.24)

Partial R-square: .33 .21

R-square = .48 Degrees of freedom = 18

where

Y_1 = sunflower yield (lbs/acre)

X_1 = weeks between inspections

X_2 = shallow tillage trips

TABLE 9. AVERAGE MEASURES OF CROP PRODUCTION PRACTICES FOR FARMS WITH HIGH AND LOW SUNFLOWER YIELDS, 1984

Measures of Crop Production Practice	Sunflower Yield		
	Low 25 %	All Farms	High 25 %
Yield (lbs/acre)	797	957	1,207
Nitrogen applied (lbs/acre)	39	39	45
Total nitrogen available (lbs/acre)[a]	103	102	115
Percent of acres treated with:			
Herbicides	100	107	102
Insecticides	120	102	99
Weeks between inspections	1.4	1.6	1.9
Shallow tillage trips[b]	2.3	2.8	3.9

[a]Applied nitrogen plus average nitrogen in soil based on 1972-1981 county average soil test results (Dahnke et al. 1982).
[b]Includes previous fall and current production year tillage.

A positive relationship existed between sunflower yield and the interval of weeks between general inspections. General inspections explain 33 percent of the variation in sunflower yields when X_2 is held constant. This indicates that these farmers which have more time between inspections or fewer inspections have higher yields. The most likely hypothesis is that education of farmers of the importance of pest control in sunflower has been successful. Farmers successfully identify the problem and treat it in the most effective manner at their disposal. Farmers with pest problems need to inspect more than farmers without pest problems.

The positive relationship between shallow tillage trips and sunflower yields was noted in the descriptive analysis. Later planting and increased row crop cultivation are likely causes. Shallow tillage explained 21 percent of the variation in sunflower yield when X_1 was held constant.

Farmers need to prevent weed and insect problems before they become production limiting. If weeds and insects can be reduced by rotation, crop selection, or chemical control programs, then the farmer will certainly increase his sunflower yields. The key practice for consideration is the foreknowledge of a pest problem and preventive strategies to avoid a serious problem before a critical phase of sunflower production arises. The relatively low R-square of this model suggests that a low level of confidence can be placed on the variables in this model. The regression coefficients indicate a relationship but should not be used to generate yield estimates.

Machinery Management

Factors used in the machinery management analysis were machinery cost per acre and repair cost per acre. Machinery cost included depreciation, fuel and lubrication, repair, and 90 percent of custom work expenses. Repair cost per acre included the amount spent for repairs of tractor and crop machines. Categories of machinery practices examined were: machinery investment, intensity of tractor use, tractor size and age, and shop facilities.

Machinery Cost Per Acre

Machinery management practices that were related to machinery cost per acre are summarized in Table 10. Tractor and combine investment are an estimate of 1984 market value. Implement values are the undepreciated balance on the farmer's depreciation schedule. Many implements that have been owned more than five years have an undepreciated value of zero because of rapid depreciation methods (ACRS). This tends to underestimate implement values and depreciation costs for equipment five or more years old. Farmers with high investment in machinery showed a higher machinery cost per acre because depreciation is an integral part of the machinery cost calculation.

TABLE 10. AVERAGE MEASURES OF MACHINERY PRACTICES FOR HIGH AND LOW MACHINERY COST PER ACRE, 1984

Measures of Machine Practice	Machinery Cost Per Acre		
	Low 25 %	All Farms	High 25 %
Machinery cost per acre	$20.25	$31.39	$47.19
Repair cost per acre	$ 2.75	$ 5.70	$ 8.58
Value:			
Implement	$ 1.53	$33.16	$81.64
Tractor	$26.09	$25.80	$31.60
Combine	$18.27	$15.80	$17.10
Tractor characteristics:			
Weighted horsepower (hp/acre)	.15	.13	.11
Tractor use (hrs/acre)	.63	.91	.97
Accumulated tractor (hrs/acre)	7.44	12.46	12.01
Shop value	$ 9.71	$14.60	$16.11
Crop acres	1,058	1,113	954

High horsepower per acre (weighted by annual hours of operation of each tractor) was associated with low machinery cost per acre. Intensity of tractor use as measured by weighted hours of annual operation per acre (weighted by individual tractor's horsepower) tends to be associated with high machinery cost per acre. Older tractors as measured by accumulated hours per acre on the tractor fleet are also associated with higher machinery cost per acre. Shop value per acre seemed to be associated with higher machinery cost per acre.

The regression model is as follows:

$$Y_1 = 7.38 + .25X_1 + .51X_2 + .82X_3 - .31X_4 - 32.2X_5 + .21X_6$$

t-value:	(3.65)	(11.32)	(6.13)	(5.01)	(-2.87)	(2.69)	(2.21)
Partial R-square:		.86	.66	.54	.26	.25	.16

R-square = .88 Degrees of freedom = 20

where

Y_1 = machinery cost per acre

X_1 = implement value per tillable acre

X_2 = tractor value per tillable acre

X_3 = total tractor hours per tillable acre

X_4 = shop value per tillable acre

X_5 = total tractor horsepower per tillable acre

X_6 = combine value per tillable acre

The model consists of components used to calculate machinery cost per acre with the exception of shop value, total tractor horsepower, and total tractor hours per acre. Total tractor horsepower and shop value per acre are negatively correlated to machinery cost per acre. Negative correlation between shop value and machinery cost per acre in this analysis differs from the descriptive analysis in Table 10. This negative correlation implies that for every \$1.00 increase in shop value, machinery cost per acre is reduced by \$.31. Apparently, when the the other factors affecting machinery cost are taken into account, a more expensive shop does reduce total machinery costs. The equation indicates that it would pay to have more expensive shop as long as shop costs are less than 31 cents per dollar invested. An increase of total horsepower of 50 will reduce machinery cost \$1.44 per acre. An increase of one hour of total tractor operation would increase total machinery cost \$8.20. This level of cost for accumulated hours on the tractor fleet indicates the benefits in efficient utilization of tractors.

Tractor, combine, and implement values were used to calculate machinery cost per acre. Recognizing this fact allows a comparison to be made between them. Tractor, combine, and implement values per acre, if increased \$1.00, would increase machine cost per acre by \$.51, \$.21, and \$.25, respectively.

Partial R-squares indicate that implement value per acre explains the largest percent of the variation in machinery cost per acre when all other variables are held constant. The major weakness in implement values was the way they were calculated, as reviewed earlier. Tractor value and total tractor hours per acre also explains a major percent of the variation in machinery cost per acre when all other variables are held constant.

Repair Cost Per Acre

Measures of machinery management that were related to repair cost per acre are shown in Table 11. Farmers with high implement values have likely purchased implements within the past five years. This indicates that larger investment in implements does not reduce repair expenses as might be expected, but actually may contribute to higher repair cost per acre.

TABLE 11. AVERAGE MEASURES OF MACHINERY PRACTICES FOR HIGH AND LOW MACHINERY REPAIR COST PER ACRE, 1984

Measures of Machine Practices	Repair Cost Per Acre		
	Low 25 %	All Farms	High 25 %
Repair cost per acre	$2.15	$ 5.71	$10.33
Implement values per acre	$5.28	$27.49	$59.99
Weighted horsepower per acre	.16	.13	.11
Annual tractor hours per acre	.54	.91	1.1
Labor (% of total repair costs)	15.2	13.4	14.7
Heating in shop (% of farms)	33	26	17
Crop acres	1,203	1,113	940

Farmers with larger tractors (weighted horsepower per acre), fewer annual tractor hours, and the ability to heat their shop had lower repair cost per acre. The relation of labor cost to total repair cost was inconclusive, but when all other variables were held constant in a regression model, a higher percent of repair cost for labor increased repair cost per acre.

Variables in the regression model were:

$$Y_1 = -2.0 + 3.53X_1 + .03X_2 + .001X_3 + .09X_4$$

t-value:	(-.80)	(3.71)	(3.01)	(2.70)	(1.95)
Partial R-square:		.38	.30	.25	.15

R-square = .59 Degrees of freedom = 22

where

Y_1 = repair cost per acre

X_1 = annual tractor hours per acre

X_2 = implement value per acre

X_3 = percent labor of repair cost

X_4 = combine value per acre

The model explains 59 percent of the variation in repair cost per acre. There is still enough variation unexplained by the model that specific coefficient values must be interpreted with caution. Partial R-squares indicate that annual tractor hours per acre explain 38 percent of the variation in repair cost per acre when all other variables in the model are held constant. Implement value per acre and percent labor explain 30 and 25 percent of the variation in repair cost per acre individually. Combine value accounts for 15 percent of the variation in repair cost per acre.

All variables in the regression model have a positive correlation to repair cost per tillable acre. Reducing annual hours of tractor operation by procuring larger machines or reduced field operations with current tractors would reduce repair cost per acre. Farmers that hire repair work, i.e., larger labor percent, have larger repair cost per acre. Higher implement and combine value per acre is also positively correlated to repair cost per acre. Implement value per acre would tend to indicate larger, more technically advanced equipment that may require more expensive repair and preventive maintenance programs.

Marketing Practices

Marketing indexes for wheat, barley, sunflower, and a composite of the three crops were developed to analyze marketing performance in 1984. The marketing indexes compared prices farmers received for their crops to the price available during harvest plus interest, storage, and shrinkage costs from harvest to the date of sale. Storage costs were limited to the cost of maintaining facilities and handling the grain. A farmer selling grain at a price higher than the harvest price plus carrying costs was given a marketing index above 100. Conversely, a farmer selling grain below the harvest price adjusted for carrying cost received a marketing index below 100.

Attempts were made to develop regression models, but none were found to meet statistical tests of significance. Therefore, the analysis deals only with descriptive statistics of marketing practices. A substantial part of the marketing data from the interviews deals with storage and storage management.

Marketing practices related to the composite marketing index are shown in Table 12. The farmers that hired charting services, subscribed to more marketing publications, and hired marketing services attained a higher composite marketing index. Participation in the wheat and barley government program in 1984 was lower for farmers with a higher overall marketing index. Few farmers used hedging, options, and forward contracting.

Marketing practices for wheat, barley, and sunflower farmers with high and low individual crop marketing indexes are summarized in Table 13. The single most important practice related to the 1984 marketing index for wheat, barley, and sunflower was the weighted average number of days from harvest (weighted by bushel volume of each sale) to date of sale. A profitable rule of thumb would have been to market these three crops prior to the end of the calendar year. This was a standard rule of thumb for several producers and the analysis here would seem to support that standard. Not all years will be this way, but the cost of storage may become prohibitive when the commodity is stored for an extended period of time. The single largest contributor to high carrying costs in the marketing index calculations is interest. Interest rates were high in 1984. As interest rates decline, the carrying cost for storage declines proportionately.

Wheat program participation was higher for farmers with a low wheat marketing index, but barley program participation was higher for those with a

TABLE 12. AVERAGE MEASURE OF MARKETING PRACTICES CLASSIFIED BY LEVELS OF COMPOSITE MARKETING INDEX, 1984

Measures of Composite Marketing Practices	Marketing Index		
	Low 25 %	All Farms	High 25 %
Marketing index	86	96	104
Number of marketing publications	.83	.93	1.1
	------------percent of farms-----------		
Hire charting	17	36	57
Hire marketing services	0	18	29
Wheat program participation	83	86	71
Barley program participation	67	54	57

TABLE 13. AVERAGE MEASURES OF MARKETING PRACTICES FOR WHEAT, BARLEY, AND SUNFLOWER CLASSIFIED BY LEVELS OF MARKETING INDEX, 1984

Measures of Marketing Practices	Marketing Index: Low 25 %	All Farms	High 25 %
Wheat marketing index	88	95	100
Weighted average days from harvest to sale	182	141	84
Program participation (percent)	100	90	75
Barley Marketing Index	89	107	125
Weighted average days from harvest to sale	192	113	118
Program participation (percent)	50	69	75
Sunflower marketing index	72	100	130
Weighted average days from harvest to sale	121	68	66
Forward contracted (percent of crop)	33	31	32

high barley marketing index in 1984. Forward contracting was a consistent practice for all sunflower producers.

One aspect of marketing that was not considered in the marketing index was deferring sales until after the first of the year for income tax reasons. Even if deferring income until the following year is desired, there is little preventing a producer from pricing the commodity in the current year and deferring the payment until the following year.

Financial Practices

Weighted cost-of-debt was used to evaluate financial performance. Weighted cost-of-debt is a weighted average interest rate (weighted by debt in various classes, i.e., real estate, chattel, and notes). The structure of debt for farmers analyzed is summarized in Table 14.

High weighted cost-of-debt farms had a much lower overall debt-to-asset ratio than low cost-of-debt farms. Examination of debt-to-asset ratios for real estate, chattel, and operation indicated that the high cost-of-debt farms had much lower D/A ratios for real estate and chattel debt than the other farms. These high cost-of-debt farms, on the other hand, had a much higher operating debt-to-asset ratio. This relationship indicated that high

TABLE 14. AVERAGE MEASURES OF FINANCIAL STRUCTURE BY SELECTED LEVEL OF WEIGHTED COST OF DEBT

Measures of Financial Structure	Weighted Cost-of-Debt		
	Low 25 %	All Farms	High 25 %
Weighted cost of debt (percent)	7.7	10.5	13.4
Total debt	$179,009	$183,589	$106,822
Total assets	$509,416	$493,017	$452,908
Total debt-to-asset ratio	.35	.37	.24
Real estate debt-to-asset ratio	.37	.34	.13
Chattel debt-to-asset ratio	.54	.51	.33
Operation debt-to-asset ratio	.16	.37	.70

cost-of-debt farms had more of their land and chattel (machinery) paid for, but were carrying a larger debt for operating expenses than the low cost-of-debt farms.

Data on lending institutions used by farmers interviewed were limited to real estate mortgages. Real estate typically was the major part of total debt for the farms studied, so comparison of real estate lending institution utilized is useful. The financial institutions used for real estate financing and the characteristics of real estate purchases are summarized in Table 15.

Weighted cost-of-debt is determined by interest rates charged by various lending institutions servicing a farm operation. Low interest cost farmers have utilized private (contract for deed) and subsidized (Farmers Home Administration) financial institutions more than the high cost-of-debt farms. High cost-of-debt farms have procured credit primarily from commercial sources. The percent of real estate debt that was refinanced was three times larger for high cost-of-debt farms than low cost-of-debt farms.

Because of reduced risk, one would expect the better financial risk farms, i.e., below .4 debt-to-asset ratio, would be paying lower interest rates. This was not the case for the farms analyzed. The low cost-of-debt farmers obtained lower cost credit from preferential sources because they had a high risk financial situation. The high cost-of-debt farms did not qualify for subsidized interest financing because they could obtain financing commercially.

Land purchasing strategies summarized in Table 15 help to explain the differences in real estate debt-to-asset ratios of low and high cost-of-debt

TABLE 15. AVERAGE MEASURES OF REAL ESTATE FINANCING INSTITUTIONS USED AND PROCUREMENT STRATEGIES CLASSIFIED BY LEVEL OF WEIGHTED COST OF DEBT

Measures of Real Estate Financing	Weighted Cost-of-Debt Low 25 %	All Farms	High 25 %
	----------percent----------		
Weighted cost-of-debt	7.7	10.5	13.4
Capital sources for real estate: (percent of financing)			
Private	44.2	30.7	20.4
Commercial	5.6	28.9	46.1
Subsidized	50.1	29.3	0.0
Refinanced real estate	6.6	21.1	19.5
Land purchasing strategies:			
Weighted average years from land purchase	9.9	9.3	10.6
Weighted average purchase price per acre	$339	$244	$85
Outstanding real estate debt per acre	$305	$217	$33

farms. The high cost-of-debt farms have owned their land only .7 more years than the low cost-of-debt farms. The average purchase price for high cost-of-debt farmers was $254 less than the low cost-of-debt farms. Much of this lower cost land was obtained through inheritances or gifts. The outstanding real estate debt is an estimate of unpaid principal on real estate mortgages. The low cost-of-debt farmers had nine times the outstanding real estate debt of high cost-of-debt farmers. This is an indication of the additional risk the low cost-of-debt farmers have when land values decline. Low cost-of-debt farmers would be insolvent in real estate if land values declined below $305 per acre. High cost-of-debt farmers could withstand an additional $272 per acre decline in land values before they would become insolvent in real estate.

Obtaining lower cost financing has been a financial strategy of the early 1980s. The low cost-of-debt farms analyzed have incorporated this strategy successfully. With declining land values, the concern of insolvency becomes important for the long-term survival of a farm operation. In this case, the high cost-of-debt farmers are in the best financial position because of lower outstanding real estate debt.

A single variable model was developed that explained a substantial part of the variation in real estate interest rate. The model consists of:

$$Y_1 = 5.88 + .067X_1$$

t-value: (29.43) (5.08)

R-square = .51 Degrees of freedom = 26

where

Y_1 = real estate interest rate (%)

X_1 = commercial financing (%)

The source of credit had a strong influence on overall weighted cost-of-capital for real estate. The equation indicates an average of 5.88 percent interest rate for noncommercial real estate financing. A 100 percent commercial financing would increase the average interest rate to 12.58 percent. Shifting real estate or other debt to a lower cost lending source can lower the overall cost of capital very quickly. This type of strategy has been employed for some time by some farm managers and is noted by this analysis.

Summary

The study identified the relative importance of factors and management practices influencing operator returns for crop farms in East Central North Dakota. It should be emphasized that the importance of variables identified may change over time depending on government programs and economic conditions in agriculture.

Results of the analysis lead to the following conclusions:

1. Machinery cost control measures, labor efficiency and high crop yields were important factors influencing operator labor returns. These were complemented by effective use of government programs.

2. Most wheat and barley producers studied could have improved yields in 1984 by increasing nitrogen fertilizer use. Management practices, such as crop rotations, that minimize the need for grass control herbicides, could also improve wheat and barley yields.

3. Delayed planting and row crop cultivation were two practices related to increased 1984 sunflower yields.

4. Machinery cost and repair cost were contained best by farmers that had larger horsepower tractors with less historical use (total hours) and fewer annual hours of operation. Farmers that could heat their shop in the winter time and made more of their own repairs had lower repair cost per acre.

5. Professional marketing assistance through charts, marketing services and publications, was more prevalent among farmers with a high composite marketing index. In 1984 a good practice was to market wheat, barley, and sunflower prior to the end of the calendar year.

6. Farmers with high debt-to-asset ratios had the lowest cost per dollar of debt. The sources of capital, i.e., contract for deed and Farmers Home Administration, explained most of the lower cost. Low debt-to-asset ratio farmers obtained their financing commercially. Consequently, their cost per dollar of debt was higher.

7. Farms with high debt-to-asset ratios have large outstanding real estate debt. Conversely, low debt-to-asset ratio farms have very small outstanding real estate debt. High debt-to-asset ratio farmers survive due to their lower cost of financing but will have serious problems with declining land values.

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