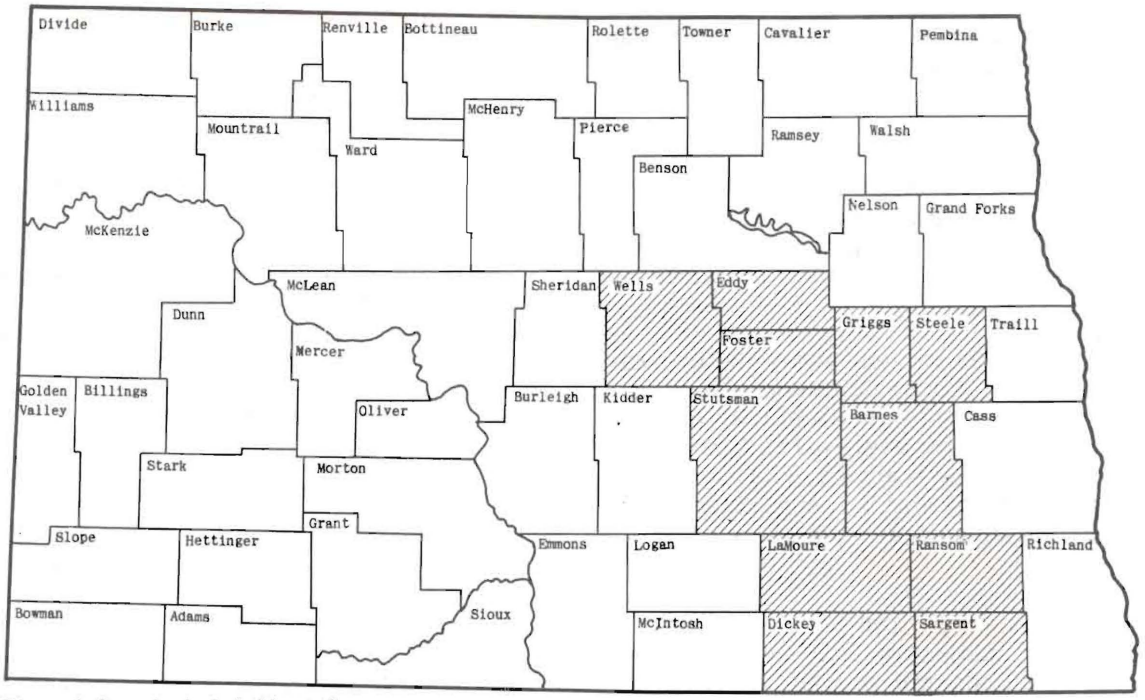

Figure 1. Counties included in study area.

Effect of Price Changes on Farm Plans In Southeast Central North Dakota

Roger G. Johnson and Wendell D. Herman

Farm planning has been difficult in recent years because of unstable prices. Operating costs have been increasing rapidly while the prices of most products produced have moved both up and down. This study examined the effect of price changes upon the most profitable farm plan for a typical farm in southeast central North Dakota. The price changes examined are for wheat, as well as for fuel and fertilizer.

The study area includes the 11 counties designated in Figure 1. This area comprises the southern portion of the Drift Prairie physiographic region. It is an undulating plain with low rounded knolls and many closed depressions or potholes. The soils are formed from glacial till and are mostly of loam and clay loam texture.[1]

Small grain and livestock is the characteristic type of farming. Wheat is the principal crop with feed grains and flax as other important crops. About one-fifth of the land in farms is not suitable for cultivation and is devoted to pasture and hay for livestock.

Representative Farm

A typical farm situation was set up to represent a medium sized farm in the area. The resources available on the farm are presented in Table 1.

The division of land between cropland, native pasture and native hay is the average proportions for the area.[2] Since land acreage was fixed, the size of farm buildings available for livestock was also fixed to keep the analysis in the same perspective for livestock as for crops.

[1] *Omodt, Johnsgard, Patterson, and Olson,* **The Major Soils of North Dakota,** *Department of Soils, Agricultural Experiment Station, Fargo, North Dakota, Bulletin 472, 1962, pp. 3-4.*

[2] **1969 Census of Agriculture,** *Vol. 1, Part 18, North Dakota, United States Department of Commerce, Bureau of Census, Washington, D. C., May, 1972.*

Dr. Johnson is professor and Herman was a graduate assistant, Department of Agricultural Economics.

Table 1. Resources available for representative farm, southeast central North Dakota

Resource	Unit	Quantity
Cropland	Acre	831
Native Pasture	Acre	107
Native Hayland	Acre	32
Other[a]	Acre	70
Total Land	Acre	1,040
Livestock Buildings	Sq. Ft.	7,700
Largest Tractor	Horsepower	100
Operator Labor	Hours	3,162
Family Labor	Hours	1,217
Hired Labor	Hours	644

[a] *Waste, roads, and farmstead*

A typical machinery complement was developed for the farm based upon a 1972 survey.[3] The largest tractor is representative of the size of other equipment on the farm. The equipment includes three tractors, a complete line of small grain equipment, including a 14-foot drill and 18-foot swather and combine, plus row crop implements and hay harvesting equipment.

The farm operator contributed a maximum of 3,162 hours of labor and management per year. The operator was willing to work a maximum of 10 hours per day during the spring, summer and fall and eight hours in the winter. The farmer was assumed to have a school-aged son who provided 60 hours of labor per month during the fall, winter and spring and 200 hours per month in the summer. A man could be hired as needed during the summer up to 644 hours.

Farm Plans

Farm plans which gave maximum returns to the resources available were calculated using a mathematical procedure known as linear programming.

The crop, forage and pasture enterprises considered were durum, spring wheat, barley, flax, oats, rye, sunflowers, corn silage, alfalfa hay, native hay, tame pasture and native pasture. Durum, spring wheat and barley could be planted on summer fallowed land or on nonfallowed land. All other crops were planted on nonfallowed land. Sunflowers were limited to 20 per cent of total cropland to prevent disease and insect problems associated with more intensive production. The barley and oats could either be sold or used as feed for livestock. Alfalfa and native hay and corn silage were produced only as feed for livestock. Pasture for livestock enterprises was provided by permanent native pasture or alfalfa-brome pasture.

The crop yields used are presented in Table 2. The yields are what can be expected using adequate fertilizer rates, timely operations and good management practices. Yields are approximately 20 per cent above average yields for the area.

Table 2. Crop yields for representative farm, southeast central North Dakota

Crop	Unit	Yield Per Acre
Wheat on Fallow	Bushel	39.8
Durum on Fallow	Bushel	34.3
Barley on Fallow	Bushel	56.0
Wheat on Nonfallow	Bushel	32.2
Durum on Nonfallow	Bushel	27.8
Barley on Nonfallow	Bushel	50.0
Oats	Bushel	71.0
Flax	Bushel	15.0
Rye	Bushel	40.0
Sunflowers	Pounds	1400.0
Corn Silage	Ton	8
Alfalfa Hay[a]	Ton	2.3
Native Hay	Ton	1.0
Tame Pasture[b]	A.U.M.	2.8
Native Pasture	A.U.M.	1.2

[a] *A five-year rotation using oats as the companion crop.*
[b] *Brome-alfalfa in a seven-year rotation using oats as the companion crop.*

Eight livestock enterprises were considered. The production from each livestock enterprise is summarized in Table 3. The existing buildings were used and equipment for beef, sheep and finishing hogs was assumed to be available. However, for hog farrowing and dairying the annual cost of specialized equipment was added to other production costs. Except for supplements all feed for livestock was produced on the farm.

Base Prices

The most profitable farm plan largely depends on the relative product prices. In any one year, relative commodity prices may deviate from their long-term relationship to each other. As a base from which to analyze changing prices, long-term average price relationships were used. For products produced, the average prices occurring over the 10 years, 1963-72, were used. The base period represents a time of rather stable prices and is long enough not to be unduly influenced by cyclical price patterns. Input prices occurring in 1974 were used for all nonfarm originating inputs.

[3] *Held, Johnson and Schaffner,* **Small Grain Production Practices and Size and Type of Machinery Used, Southeast Central North Dakota,** *Statistical Series No. 17, Department of Agricultural Economics, North Dakota State University, Fargo, April, 1973.*

Table 3. Production from livestock enterprises considered in farm plans, southeast central North Dakota

Livestock	Production
Beef Cow-Calf Sold	90% calf crop 420 lbs. weaning weight
Beef Cow-Calf Backgrounded	90% calf crop 705 lbs. calf sold
Background Purchased Calf	285 lbs. gain
Sow and 2 Litters—Sell Feeder Pigs	15 pigs sold per sow 40 lbs. selling weight
Sow and 2 Litters—Sell Slaughter Hogs	14.8 hogs sold per sow 225 lbs. selling weight
Finish Purchased Feeder Pigs[a]	185 lbs. gain 1.5% death loss
Dairy	12,000 lbs. milk/cow 25% culling rate
Ewe and Slaughter Lamb	1.2 lambs per ewe 110 lbs. lamb and 10 lbs. wool

[a] *Includes alternatives of finishing three groups per year or finishing only one group during the winter.*

Base period product prices were increased to account for increased costs and the elimination of most government support payments between the base period and 1974. The increase was calculated so as to generate approximately the same net farm income as occurred during the base period. Increases in prices paid since the base period were accounted for by increasing product prices 53 per cent based on the change in the Index of Prices Paid by farmers. During the base period, wheat and feed grain payments averaged 16 per cent of farm sales. To account for the discontinuance of these payments, product prices were increased another 16 per cent for a total adjustment of 69 per cent. Base prices for products used in the analysis are shown in Table 4.

Table 4. Base prices used in farm planning analysis, southeast central North Dakota

Product	Unit	Price
Spring Wheat	Bushel	$ 2.70
Durum Wheat	Bushel	2.70
All Barley	Bushel	1.50
Flax	Bushel	4.70
Rye	Bushel	1.55
Oats	Bushel	.95
Sunflowers	Cwt.	7.27
Feeder Steers	Cwt.	55.00
Feeder Heifers	Cwt.	49.00
Yearling Steers	Cwt.	48.00
Yearling Heifers	Cwt.	43.50
Slaughter Lambs	Cwt.	38.45
Feeder Pigs	Head	28.00
Slaughter Hogs	Cwt.	35.00
Wool	Cwt.	70.00
Milk	Cwt.	7.35

Most Profitable Farm Plan

The farm plan giving the largest net return to the available land, labor, machinery and livestock buildings was computed using the base prices. The results are given in Table 5.

Table 5. Returns and profit maximizing farm plan using 1963-72 price relationships, representative farm, southeast central North Dakota

Item	Unit	
Return to Labor & Management	Dollar	39,705
Enterprises		
Wheat on Nonfallow	Acre	457
Barley on Nonfallow	Acre	129
Rye on Nonfallow	Acre	21
Sunflowers	Acre	166
Alfalfa Hay[a]	Acre	58
Native Hay	Acre	32
Native Pasture	Acre	107
Beef Cow-Calf Backgrounded	Cow	16
Sow & 2 Litters - Sell Feeders	Sow	47
Background Purchased Calf	Calf	180

[a] *Includes 12 acres of oats used as a companion crop to establish 1/5 of alfalfa each year.*

Wheat and sunflowers grown on nonfallowed land were the most profitable cash crops. Sunflowers were produced to the limit of the rotational restriction and wheat took up most of the remaining land not needed to produce livestock feed. A small acreage of rye was produced to alleviate a shortage of spring labor.

Feeder pig production was the most profitable livestock enterprise. A purchased calf for backgrounding enterprise provided employment for available winter labor. The small beef cow herd was included to utilize available native pasture.

The Effect of Wheat Price on Farm Plans

The price of wheat was varied by $.25 increments from $1.95 to $8.45 per bushel, while all other prices were held constant. Most profitable farm plans were calculated at each wheat price. The results are shown in Table 6.

Table 6. Effect of wheat prices on most profitable farm plans, representative farm, southeast central North Dakota

Enterprises	Wheat Price (dollars) 1.95-2.20	2.45	2.70	2.95-3.95	4.20-4.45	4.70-5.70	5.95-6.95	7.20-8.45
Wheat (acres)	—	197	457	582	635	661	664	675
Barley (acres)	250	131	129	128	75	50	48	38
Flax (acres)	310	216	—	—	—	—	—	—
Rye (acres)	49	68	21	—	7	21	—	—
Sunflowers (acres)	166	166	166	65	89	91	89	89
Alfalfa[a] (acres)	56	52	58	55	24	7	14	10
Tame Pasture (acres)	—	—	—	—	—	—	16	19
Native Hay	32	32	32	32	32	32	32	32
Native Pasture	107	107	107	107	107	107	107	107
Cows-Background-Calf	16	13	16	16	16	16	21	—
Cows-Sell Calf	—	—	—	—	—	—	—	22
Sows-Sell Feeders	51	54	47	52	47	47	45	42
Background Calf	171	172	180	168	58	—	—	—

[a] *Includes 1/5 acres of oats companion crop for each acre of alfalfa to establish the stand.*

With the wheat price in the $1.95 to $2.20 range, flax, sunflowers and barley are the most profitable crops. About half of the barley production was utilized by livestock and the rest sold. At a $2.45 wheat price some of the flax acreage was replaced by wheat, but flax was not totally replaced until wheat reached a price of $2.70. At $2.70 a bushel wheat became the primary cash crop and all

Table 7. Effect of changes in fuel and fertilizer prices upon net returns and optimum farm plans, representative farm, southeast central North Dakota

Prices of Fertilizer and Fuel:				
Nitrogen Per Lb.	$.18	$.34	$.41	$ .49
Phosphate Per Lb.	.16	.30	.36	.43
Diesel Fuel Per Gal.	.36	.68	.82	.97
Gasoline Per Gal. (tax exempt)	.37	.70	.85	1.00
Return to Labor and Management	$39,705	$31,317	$28,816	$26,605
Enterprise Organization:				
Wheat on Nonfallow 50# N	457	—	—	—
Wheat on Nonfallow 40# N	—	111	—	—
Wheat on Fallow 20# N	—	28	86	39
Barley on Nonfallow 45# N	129	129	129	—
Barley on Fallow 10# N	—	—	—	113
Flax 10# N	—	310	310	311
Rye 70# N	21	—	—	—
Sunflowers 20# N	166	166	166	166
Alfalfa Hay[a]	58	58	54	50
Native Hay	32	32	32	32
Native Pasture	107	107	107	107
Beef Cow - Background Calf	16	16	16	16
Sow & 2 Litters - Sell Feeders	47	47	53	59
Background Purchased Calf	180	180	166	149

[a] *Includes 1/5 acre of oats companion crop for each acre of alfalfa.*

barley production was for feed. At a wheat price of $2.95 wheat partially replaced sunflowers. The livestock enterprises remained relatively stable until wheat reached a price of $4.20 per bushel. At that price the purchased calves for backgrounding were substantially reduced due to the high opportunity cost of producing barley. When wheat was increased to $7.20, it became more profitable to sell the calves from the beef cow herd at weaning and further reduce barley production. A limitation in seeding capacity prevented further specialization in wheat at the higher price levels. Converting native hay and pastureland to wheat was not an allowed alternative.

The Effect of Fuel and Fertilizer Prices on Farm Plans

Fuel and fertilizer prices tend to move together since they are both related to the price of energy. In this analysis, both fuel and fertilizer prices were increased by 10 per cent increments up to three times the base price. Three alternative levels of nitrogen fertilizer for wheat on nonfallow were included for this analysis. Yields were 32.2 for 50 pounds N, 31.0 for 40 pounds N, and 26.1 for 20 pounds N. Results of the analysis are presented in Table 7.

The profit maximizing enterprise organization was not affected until fertilizer and fuel prices nearly doubled from their base levels. At this price level. 309 acres of wheat were replaced by flax due to lower fertilizer requirements. On the remaining wheat, the nitrogen fertilizer rate was dropped to 40 pounds per acre and a portion was raised on summer fallow. At higher fertilizer and fuel prices, both wheat and barley were grown on summer fallow to reduce nitrogen fertilizer requirements. Fertilizer and fuel prices had little effect on the optimum livestock organization. Returns to labor and management were reduced $13,100 between the lowest and highest fuel and fertilizer prices.

Conclusions

Changes in wheat prices tended to change the most profitable mix of small grains and flax on a typical farm in the study area. Wheat price had less effect on the profitablity of sunflowers because they did not compete as directly for labor at the same time of the year. At high wheat prices livestock feeding was less attractive. However, the use of more tillable land, existing buildings and available labor continued to find profitable use with breeding livestock.

Increases in fertilizer prices tended to make flax profitable relative to wheat and reduce fertilizer application rates. Increased nitrogen prices made the practice of summer fallowing an economical way to reduce purchased nitrogen. Higher fuel prices had little effect on farm plans but reduced net income.