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An Analysis of Irrigation Farming in the Warwick-McVille Project Area

Report of the "MIP" Interdisciplinary Research Team
North Dakota Agricultural Experiment Station
North Dakota State University
of Agriculture and Applied Science
Fargo, North Dakota
in cooperation with
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and
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Carrington, North Dakota

AGRICULTURAL EXPERIMENT STATION
NORTH DAKOTA STATE UNIVERSITY
FARGO, NORTH DAKOTA 58105

Foreword

The Marketing Irrigation Production research team is charged with the responsibility of evaluating the crop and livestock alternatives and market potential of agricultural production from the Garrison Diversion Irrigation Project. This report covers the work of the interdisciplinary team for the Warwick-McVille irrigation area.

The study examines the effects of irrigating 270 of a 1,050 acre model farm in the Warwick-McVille irrigation area. An analysis is included for normal and optimum managerial performance on low and high available water capacity soils. A crop only farm and a combination crop and livestock farm were considered with the inclusion and exclusion of selected specialty crops and livestock enterprises. The purpose of this report is to identify profit maximizing irrigated and dryland cropping patterns with and without livestock alternatives and/or specialty crops. Production costs and returns for specific crops are not reported in this publication.

The results of this study can provide guidance to irrigators in the Warwick-McVille project area. Numerous historic base period values are employed in the analysis which should not be used to evaluate current period costs and returns for irrigated or dryland enterprises. The study emphasis is directed toward estimates of long-run profit maximizing farm plans in the irrigation area.

This report is a cooperative effort of the MIP research team with Mr. Harvey Vreugdenhil acting as senior author. The members of the MIP team are:

Project Coordinator:

Donald Anderson	Professor of Agricultural Economics

Department Representatives:

Clayton Haugse	Chairman and Professor of Animal Science
Roger Johnson	Professor of Agricultural Economics
Dwain Meyer	Associate Professor of Agronomy
Donald Patterson	Associate Professor of Soils
Earl Scholz	Associate Professor of Horticulture

Other Team Members:

LeRoy Schaffner	Associate Professor of Agricultural Economics
Lars Jensen	Assistant in Agronomy
Harvey Vreugdenhil	Research Associate in Agricultural Economics

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United States Bureau of Reclamation
The Garrison Conservancy District

Financial support of these agencies has increased the effort expended for research of irrigated agriculture in North Dakota. The added funding has made it possible for the Experiment Station to utilize additional resources in studying ways of using North Dakota's water resources more efficiently.

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Introduction

The **M**arketing **I**rrigation **P**roduction (MIP) interdisciplinary research was formed to determine the optimum combination of irrigated crops, dryland crops, and livestock enterprises and to evaluate the market potential of agricultural production from the Garrison Diversion Irrigation Project. The MIP team consists of research scientists from the departments of Agricultural Economics, Agronomy, Animal Science, Horticulture, and Soils at North Dakota State University.

The Garrison Diversion Irrigation Project was divided into three general areas: north, central, and south. The criteria for dividing the district into three areas were length of growing season, amount of rainfall, current farming practices, and present and potential markets. The northern area, composed of the Souris Loop and Karlsruhe irrigation areas, as shown in Figure 1, contains approximately 116,000 acres in parts of Bottineau and McHenry counties. The 74,670 acres in the central area includes all land in the Lincoln Valley, New Rockford, and Warwick-McVille irrigation areas covering parts of Sheridan, Eddy, Benson, and Nelson counties. The southern area—composed of the LaMoure, East and West Oakes irrigation areas—encompasses 59,330 acres in parts of Stutsman, LaMoure, Dickey, Sargent, and Ransom counties.

Description of the Warwick-McVille Irrigation Area

The Warwick-McVille irrigation district consists of 68,155 acres in portions of Benson, Eddy, and Nelson counties. According to Bureau of Reclamation standards, the area contains 3,327 acres of Class 1 land; 26,455 acres of Class 2 land; and 38,373 acres of Class 3 land. The soils of some of the Class 1 land are comparable to those described in this report as "high available water capacity soils" and much of the Class 3 land has soils similar to those described as "low available water capacity soils."[1]

The area occupies a portion of the glaciated upland which borders the Sheyenne River Valley on the north. Much of the area was eroded by glacial meltwater and subsequently covered by several feet of stratified glacial outwash. The land surface is nearly level except for a few undulating to rolling areas of coarse glacial outwash and an occasional "high" of glacial till. A few hummocky areas occur in northeastern Eddy County and adjoining parts of Benson and Nelson counties where the sandy soil material has been restored by wind. The area lacks an established surface drainage pattern except for the deep drainage ways, such as Tolna Coulee, which extends laterally into the upland from the Sheyenne River Valley. Most surface water infiltrates the soil or collects locally in depressions and sloughs.

Much of the irrigable acreage consists of soils with 10 to 20 inches of loam or sandy loam over coarse sand and gravel which contains varying amounts of shale. Extensive areas of soils on deep sandy sediments occur in parts of the district. A few areas are dominated by soils on loamy, water-laid sediments; several of these areas are characterized by high-lime soils with seasonally high water tables. Low islands of loamy glacial till occur throughout the district; some of these areas are partially mantled by wind-deposited sandy material.[2]

The Irrigated Model Farm

A model farm was developed as a tool to determine the most profitable method to integrate irrigation into a farm plan. The model farm does not represent a particular farm but was considered representative of a typical farm in the Warwick-McVille irrigation area.

The model farm consists of 1,340 acres of which 1,050 acres are cropland, 240 acres are native pasture, and 50 acres are farmstead and wasteland. Two center pivot irrigation systems are used to irrigate 270 of the 1,050 cropland acres. Machinery requirements for the model farm are based on the average inventory for farms of a similar size.

Family labor is provided by the farm operator and his school age child. A full-time hired man is employed for approximately 8 months on the crop farm and for 12 months on the crop and livestock farm. Additional seasonal labor is hired as needed for harvesting potatoes and sugarbeets when these crops were produced.

A model farm with identical resource constraints was developed for each of two soil textured groups—coarse and medium textured. The two soil textural groups were used because of 1) the relationship between soil texture and available water capacity; 2) the predominance of these textural groups in the area; and 3) the difference in management requirements and crop yields between coarse-textured and medium-textured soils, particularly under dryland conditions.

Normal or optimum managerial ability was assumed for the model farm. Crop yields under normal management reflect the skills of beginning irrigators or irrigators whose management practices limit production. Optimum management represents the "know-how" of experienced irrigators and the full application of known technology. The difference between the two management levels is in the selection, timeliness, and performance of production practices which are reflected in crop yields.

[1] Available water is the portion of water in a soil which can be absorbed by plant roots. Available water capacity is the capacity of a soil to store water for plant use, usually expressed in linear depths of water per unit depth of soil. In the Warwick-McVille area, **high available water capacity** soils are mainly medium-textured (loam or silt loam) through the rooting zone and capable of storing at least nine inches of plant available water within a 5-foot vertical section of soil (USDA-SCS standards). Soils with **moderate available water capacity** are moderately coarse textured (fine sandy loam or sandy loam) and have plant available water storage capacities of 6 to 9 inches within a 5-foot section of soil. Soils with **low available water capacity** are coarse textured (loamy fine sand or loamy sand) throughout the rooting zone or soils with loam or sandy loam over sand and gravel at relatively shallow depths. These soils have less than 6 inches of water storage capacity to a depth of 5 feet. The available water capacity of a soil is an important factor in determining the amount of irrigation water which can be applied at one time and the frequency of application required. Coarse-textured soils, for example, hold less plant available water per foot of soil than do medium-textured soils and must be irrigated more often during periods of low rainfall and/or high water uptake by plants.

[2] Additional general information on the soils of the Warwick-McVille irrigation district is in Patterson, D. D., **et al.**, "Soil Survey Report County General Soil Maps North Dakota," North Dakota Agricultural Experiment Station Bulletin 473, 1968. More detailed soils information for the area is in Wright, M. R., and M. D. Sweeney, "Soil Survey of Eddy County and Parts of Benson and Nelson Counties, North Dakota," USDA-SCS and North Dakota Agricultural Experiment Station, U.S. Government Printing Office, Washington, D.C., 1977.

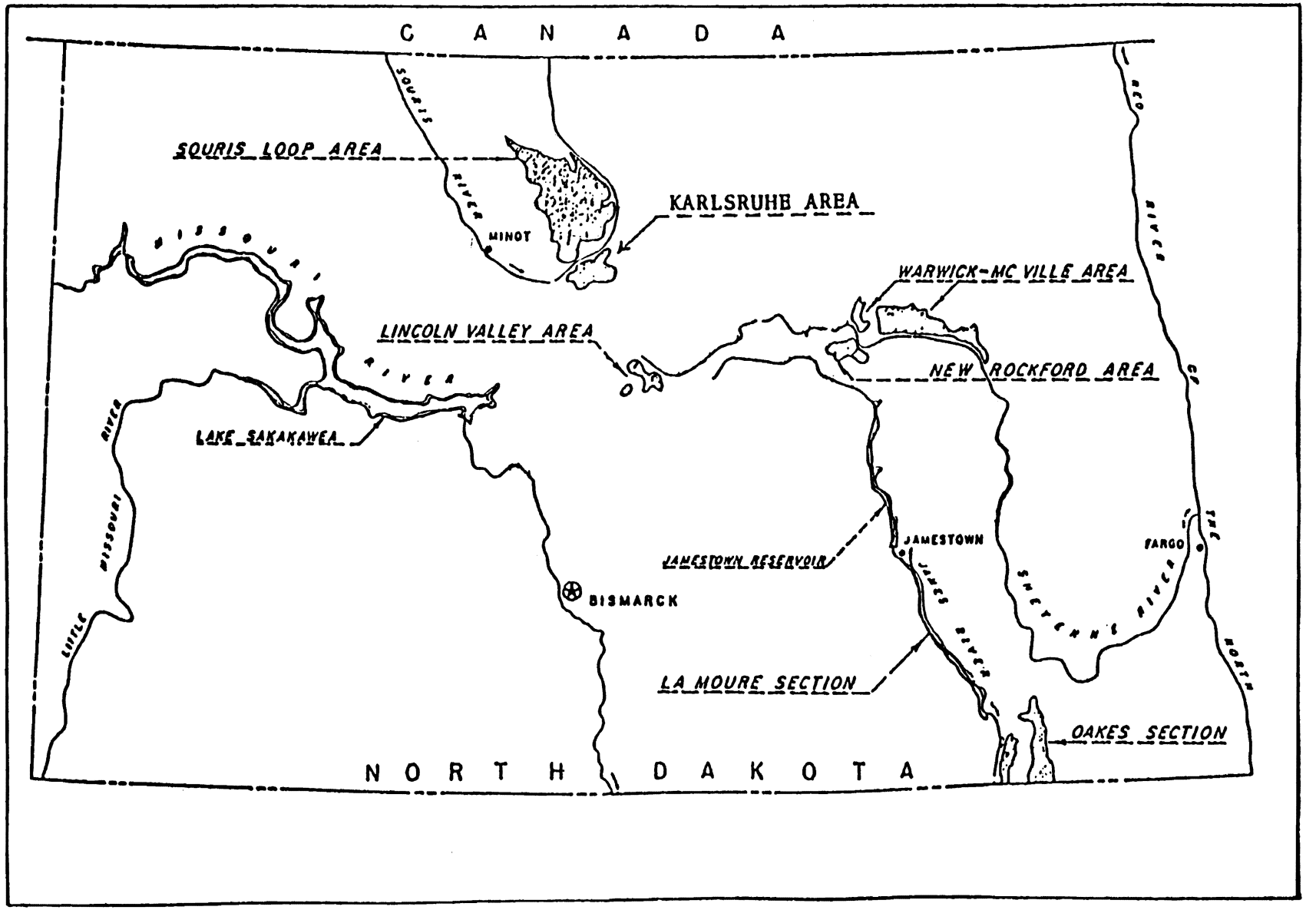

Figure 1. Initial Irrigation Areas of the Garrison Irrigation Project.

Normal management for livestock production was intended to reflect current practices while optimum management reflects improved production practices. The difference between the two livestock management levels was reflected in hog weaning rates, the per cent calf and lamb crop for the beef cow and sheep enterprises, and milk production per cow for the dairy enterprises. No differences between management levels were assumed for the livestock feeding enterprises.

Product Prices

Product prices were established to represent average price relationships. It should be recognized that in any given year, price relationships may differ from normal. These relative prices for the different crop and livestock commodities were based on the average prices during the 10-year period 1963-1972 (Table 1). It was assumed that average prices over this period represented price relationships that could be projected into the future. The base period selected was long enough so it would not be influenced unduly by cyclical price patterns; yet, short enough to reflect recent trends in relative prices. Increases in prices paid by farmers (Parity Index) since 1963-1972 were taken into account by increasing product prices by the per cent increase in the index of prices paid by farmers between the base period and March, 1974. The relative prices for all inputs are therefore at 1974 levels.

The prices used do not reflect predictions for a particular year in the future. Inflation is expected to continue, so actual prices of both inputs and products produced will be higher by the time Garrison Project water is used on farms. The results of the enterprise analysis would not be changed by increasing both input and product prices by some estimate of the inflation rate.

Crop and Livestock Enterprises

Crop and livestock production practices and yields are based upon the recommendations and expectations of agronomists, animal scientists, horticulturists, and soil scientists at North Dakota State University. Production requirements and yield estimates were made for each selected crop for the two soil textural groups having different available water capacities and for the two operator management levels. Assumptions made when establishing estimates for the various irrigated dryland and livestock enterprises included:

1. Good quality seed of adapted varieties or hybrids is available.
2. Adequate supplies of fertilizer, herbicides, and insecticides are available.
3. Drainage operations will proceed with irrigation development.
4. Adequate supplies of irrigation water will be available as needed for all crops.

TABLE 1. CROP AND LIVESTOCK SELLING AND PURCHASE PRICES USED IN STUDY

Crop or Livestock Enterprise	Units	Selling Price	Purchase Price
Corn Grain	Bushels	$ 1.75	$
Sunflowers (Oil)	Hundredweight	7.90	
Sunflowers (Confectionery)	Hundredweight	9.15	
Pinto Beans	Hundredweight	12.50	
Navy Beans	Hundredweight	14.00	
Potatoes (Late)	Hundredweight	2.90	
Sugarbeets	Tons	22.50	
Wheat	Bushels	2.70	
Flax	Bushels	4.70	
Barley	Bushels	1.50	1.62
Millet	Hundredweight	4.15	
Winter Rye	Bushels	1.55	
Oats	Bushels	.95	1.07
Alfalfa Hay	Tons	30.00	
Alfalfa-Brome Hay	Tons	27.00	
Tame Grass Hay	Tons	27.00	
Feeder Pigs	Hundredweight	70.00	72.50
Slaughter Pigs	Hundredweight	35.00	
Steer Calf	Hundredweight	55.00	55.74
Heifer Calf	Hundredweight	49.00	49.74
Backgrounded Steer	Hundredweight	48.00	48.67
Backgrounded Heifer	Hundredweight	43.50	44.17
Yearling Steer	Hundredweight	46.00	
Yearling Heifer	Hundredweight	44.50	
Feeder Steer	Hundredweight	46.50	
Sheep	Hundredweight	40.30	
Milk	Hundredweight	7.35	
Hired Labor	Hour		3.00
Rented Irrigated Land	Acre		50.00
Native Pasture	AUM	3.75	3.75

5. The amount of irrigation water required for soils with low and high available water capacity at both management levels is the same since a given amount of water is required to produce a particular type of crop.
6. Crop acreage is limited by the farm equipment needed for timely operation.
7. Peak labor loads are determined from the approximate farm operation dates where combinations of crop and livestock enterprises are employed on the same farm.
8. Natural disasters, such as hail, insects, disease, or frost, were not considered in establishing crop yield estimates.
9. Types and size of livestock enterprises were based on size of livestock facilities predominant in the area.
10. All feed or livestock were home raised except in specialized cases.

Costs and returns were calculated for each crop and livestock enterprise using a computer budgeting system which standardized the labor needs and costs for the machinery used. A budget was calculated for each of the following crop and livestock enterprises:

Irrigated Crops	Dryland Crops	Livestock
Hay (Alfalfa or Alfalfa- Brome)	Hay (Alfalfa or Alfalfa-Brome)	Sow With Two Litters
Corn Grain	Corn Silage	Finishing Feeder Pigs
Corn Silage	Barley	Beef Cow Herd
Pinto Beans	Flax	Backgrounding Calves
Navy Beans	Millet	Backgrounding Yearlings
Late Potatoes	Oats	Finishing Steers
Barley	Confectionery Sunflowers	Dairy
Oats	Oil Sunflowers	Sheep
Sugarbeets	Winter Rye	
Confectionery Sunflowers	Durum	
Oil Sunflowers	Hard Red Spring Wheat	
Flax	Alfalfa-Brome Pasture	
Durum	Tame Grass Pasture	
Hard Red Spring Wheat	Native Pasture	
Alfalfa-Brome Pasture		

All crops were grown in rotation except corn grain, corn silage, and native pasture. Corn could be grown either in rotation or continuously. The per cent of land in certain crops was limited to control disease. Irrigated wheat, barley, and oats were limited to a maximum of 50 per cent of the irrigated land. Field beans, potatoes, sugarbeets, and flax were limited to 33 per cent and sunflowers to 25 per cent of the total irrigated land. Dryland rotational limitations restricted wheat up to 50 per cent; sunflowers to 25 per cent; and oats, barley, and millet up to 33 per cent of the dryland acreage. Winter rye was limited so it would not exceed the total acreage in other small grain production and/or fallow. Hay was limited to 33 per cent of the irrigated acreage and/or 20 per cent of the dryland acreage. Additional rotational restrictions may be required if crop disease becomes prevalent in the area. For example, white mold is not very common in the state to date, but can spread, especially under irrigation. Sunflowers and field beans are most susceptible to white mold and to a lesser extent, sugarbeets and potatoes are susceptible. The carryover effect of herbicides used on the previous year's crop must be considered to avoid crop injury. Volunteer crops may also be a problem; for example, sugarbeets following sunflowers.

The size of the swine enterprise was limited to a maximum of 40 sows and 672 feeder pigs. The size of the feeder cattle, beef cow, sheep, and dairy enterprises was limited to a maximum of 500, 400, 500, and 100 head, respectively, when all livestock enterprises were included as alternatives.

A planning technique called linear programming was used to study the economic feasibility of alternative crop and livestock enterprises. Relative costs and returns together with land and labor requirements were analyzed for each enterprise to find the combination that would yield the highest net income.

The majority of the discussion in this report deals with normal management on soils with low available water capacity since it was estimated that, initially, normal management will likely apply to a high percentage of the irrigators. Also, soils with low available water capacity are predominant in the Warwick-McVille irrigation area.

Dryland and Irrigated Farm Production Operations Compared

Table 2 provides a comparison of the dryland and irrigated yields for selected crops in the Warwick-McVille irrigation area. Irrigation can provide an increased feed supply, stabilize crop production, and provide the opportunity to raise certain specialty crops not feasible under dryland operation. For example, the irrigated durum yield for normal management on soils with low available water capacity increased 262 per cent over the dryland yield. Irrigation permitted a third cutting of alfalfa hay which helps to increase the annual yield per acre.

TABLE 2. ESTIMATED DRYLAND AND IRRIGATED YIELD PER ACRE BY MANAGEMENT LEVEL AND AVAILABLE SOIL WATER CAPACITY FOR SELECTED CROPS IN WARWICK-McVILLE AREA

	Available Soil Water Capacity			
	Low		High	
Crops	Normal Management	Optimum Management	Normal Management	Optimum Management
Durum (Bushels)				
Irrigated	47.0	66.0	56.0	70.0
Dryland	13.0	17.0	27.0	37.0
Hard Red Spring (Bushels)				
Irrigated	44.0	62.0	53.0	66.0
Dryland	12.0	16.0	25.0	34.0
Barley (Bushels)				
Irrigated	55.0	77.0	66.0	82.0
Dryland	17.0	25.0	35.0	51.0
Oats (Bushels)				
Irrigated	74.0	104.0	88.0	110.0
Dryland	22.0	34.0	45.0	70.0
Flax (Bushels)				
Irrigated	19.0	27.0	23.0	29.0
Dryland	6.0	8.0	12.0	18.0
Sunflowers (Oil) (Pounds)				
Irrigated	1,610.0	2,240.0	1,920.0	2,400.0
Dryland	500.0	650.0	900.0	1,200.0
Alfalfa (Year of Establishment) (Tons)				
Irrigated	1.5	2.2	1.7	2.2
Dryland	—	—	—	—
Alfalfa (First Year) (Tons)				
Irrigated	4.6	6.0	5.0	6.0
Dryland	2.4	2.7	3.2	3.5
Alfalfa (Second Year) (Tons)				
Irrigated	4.3	5.1	4.7	5.1
Dryland	1.6	1.8	2.4	2.6
Alfalfa (Third Year) (Tons)				
Irrigated	3.8	4.2	4.1	4.2
Dryland	1.2	1.3	1.8	2.0
Alfalfa-Grass Pasture (AUM)				
Irrigated	6.5	7.7	7.0	7.7
Dryland	2.3	2.7	3.2	3.8

Crop and Livestock Farm on Low Available Water Capacity Soils

The dryland model farm consisted of 1,050 cropland acres and 240 acres of native pasture with labor provided by the farmer, one school age child, and a hired man. It was assumed that livestock feed would be produced on the farm. The profit maximizing dryland farm plan under normal management produced a net income[3] of $4,700, but a net income of $27,800 for optimum management (Table 3). The most profitable farm plan without irrigation under normal management had alfalfa hay, durum on fallow, corn silage, oats, grain, and barley. The farm plan under optimum management without irrigation consisted of sunflowers, durum, alfalfa hay, winter rye, corn silage, and barley. Alfalfa hay and barley were produced at their rotational limits on both farms. The livestock enterprises consisted of sows with two litters, finishing feeder pigs, and dairy and/or a beef cow herd. Native pasture was not fully utilized by the livestock enterprise since nonpasture using enterprises made better use of available resources. The pasture not utilized by the livestock enterprises was leased at $3.75 per animal unit month.

[3]Net income is defined as total receipts including inventory changes minus total expenses including depreciation. No charge is made for land or the labor of the farm operator and his family. Also, certain overhead expenses—such as telephone, electricity, and the farm office—have not been included in expenses.

TABLE 3. CROP AND LIVESTOCK ENTERPRISE COMBINATIONS PROVIDING HIGHEST PROFIT, LOW AVAILABLE WATER CAPACITY SOILS, NO SPECIALTY CROP, WARWICK-McVILLE IRRIGATION AREA

	Dryland Only		Dryland-Irrigated	
	Normal Management	Optimum Management	Normal Management	Optimum Management
Net Income	$4,700	$27,800	$14,700	$39,500
Irrigated Crops (Acres)				
Sunflowers (Oil)				68
Durum			37	37
Corn Grain			165(100)[a]	134(100)
Alfalfa Hay			45(100)	20(100)
Corn Silage			23(100)	11(100)
Total			270	270
Dryland Crops (Acres)				
Sunflowers (Oil)		33		124
Durum		127		165
Durum on Fallow	115		260	
Fallow	115		260	
Alfalfa Hay	210(100)	210(61)	165(62)	190(100)
Winter Rye		95	85	233[b]
Corn Silage	77(100)	60(100)		
Oats Grain	8(100)		10(100)	
Barley	525(100)[c]	525(100)[c]		68(100)
Total	1,050	1,050	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050
Native Pasture	240(92)	240(35)	240(100)	240(100)
Livestock (Head)				
Sow With Two Litters	40	40	40	40
Feeder Pigs	272	605	516	671
Beef Cow	43		83	
Feeder Steers			20	
Sheep				487
Dairy	47	48	44	32

[a] ( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.
[b] A large acreage of winter rye was produced because of a shortage of spring planting labor.
[c] A large acreage of barley was produced to provide feed for the livestock enterprise since no feed was purchased.

The linear programming model attempts to fully utilize all resources on the model farm. Full resource utilization can produce results which may be impractical in an actual farm operation. The profit maximizing farm plan may include a small acreage of a crop or a few head of livestock which could be eliminated with slight change in net income.

Sometimes the size of an enterprise changes with a minor price change. Price sensitivity information helps determine closely competing enterprises which could be substituted without decreasing net income significantly. For example, a slight decrease in the price of durum would increase the production of sunflowers.

Irrigated Model Farm

All dryland crops, irrigated crops, and livestock enterprises previously listed—except for potatoes, sugarbeets, field beans, and confectionery sunflowers—were included in the irrigated farm analysis. It was assumed that the excluded crops have market limitations which would limit the acreage.

The irrigated model farm was the same as the dryland farm except 270 acres were irrigated leaving 780 dryland crop acres. Irrigating 270 acres increased net income 213 per cent for normal management and 42 per cent under optimum management (Table 3). The dryland crops changed with barley and corn silage replaced by feed produced on irrigated acreage (corn grain and corn silage). Alfalfa hay for both management levels and sunflowers for optimum management were produced at the limit permitted. The increase in acreage devoted to fallow and/or winter rye was influenced by a shortage of labor.

The acreage devoted to providing livestock feed decreased with the irrigation of 270 acres. In fact, additional feed was available to increase the size of the livestock enterprises. The finishing feeder pig enterprise was increased to utilize the pigs produced by the sow and litter enterprise instead of selling them as feeders. The model farm under normal management increased the beef cow herd and started a small feeder cattle enterprise while under optimum management a sheep herd was started with the increased feed produced on the irrigated land. The size of the dairy herd decreased under both management levels. A slight decrease in the price of durum wheat would increase the acreage devoted to alfalfa hay and/or corn grain under either management level.

Crop and Livestock Farm on High Available Water Capacity Soils

The dryland farm plan under normal management had a net income of $38,700 while under optimum management net income was $68,300 (Table 4). Irrigating 270 acres increased net income 19 per cent over the dryland farm situation under normal management and 7 per cent under optimum management. With irrigation, dryland crops changed only in the acreage devoted to each crop except that flax under optimum management was not produced. Irrigated and dryland durum and alfalfa hay

TABLE 4. CROP AND LIVESTOCK ENTERPRISE COMBINATIONS PROVIDING HIGHEST PROFIT, HIGH AVAILABLE WATER CAPACITY SOILS, NO SPECIALTY CROPS, WARWICK-McVILLE IRRIGATION AREA

	Dryland Only		Dryland-Irrigated	
	Normal Management	Optimum Management	Normal Management	Optimum Management
Net Income	$38,700	$68,300	$46,000	$72,900
Irrigated Crops (Acres)				
Sunflowers (Oil)				28
Durum			135	135
Corn Grain			98(100)[a]	107(100)
Alfalfa Hay			37(100)	
Total			270	270
Dryland Crops (Acres)				
Sunflowers (Oil)	184	185	139	132
Durum	299	396	390	390
Flax		40		
Alfalfa Hay	210(40)	210(43)	173(4)	210(83)
Corn Silage	32(100)	28(100)	32(100)	16(100)
Barley	325(100)	191(100)	46(100)	32(100)
Total	1,050	1,050	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050
Native Pasture	240(33)	240(35)	240(33)	240(99)
Livestock (Head)				
Sow With Two Litters	40	40	40	40
Feeder Pigs	516	342	516	518
Sheep				500
Dairy	40	47	40	27

[a] ( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.

were produced at their permitted levels. Under normal management, adding irrigation did not change livestock enterprises. Under optimum management the number of feeder pigs fattened to market weight increased 51 per cent and the sheep flock was added to replace part of the dairy herd. A slight decrease in the price of irrigated sunflowers and/or durum would increase the acreage devoted to irrigated alfalfa hay under both management levels while decreasing dryland alfalfa hay acreage.

All-Crop Farm on Low Available Water Capacity Soils

Since not all farmers in the Warwick-McVille irrigation area will want to produce livestock, the model farm also was analyzed for crop enterprises only. A full-time hired man was employed for approximately eight months.

Land tended to restrict net income when only crops were produced, while labor tended to restrict net income for the livestock enterprises. The reason for higher net income on the model farms with livestock was due to the full utilization of off-season labor and more total labor.

The dryland farm plan with normal management produced oil sunflowers, durum, millet, and alfalfa hay (Table 5). All crops except millet were produced at their rotational limits. Irrigating 270 of the 1,050 cropland acres increased net income 536 per cent. Irrigated acreage was used for durum, oil sunflowers, and alfalfa hay. Dryland crops produced were similar in both farm situations except in the number of acres devoted to each crop. All irri-

TABLE 5. CROP ENTERPRISE COMBINATIONS PROVIDING HIGHEST PROFIT, LOW AVAILABLE WATER CAPACITY SOILS, NO SPECIALTY CROPS, WARWICK-McVILLE IRRIGATION AREA

	Dryland Only		Dryland-Irrigated	
	Normal Management	Optimum Management	Normal Management	Optimum Management
Net Income	$1,100	$10,600	$7,000	$23,500
Irrigated Crops (Acres)				
Sunflowers (Oil)			68	68
Durum			135	135
Flax				14
Alfalfa Hay			67	53
Total			270	270
Dryland Crops (Acres)				
Sunflowers (Oil)	263	263	195	195
Durum	525	525	390	390
Flax		52		28
Millet	52		52	10
Alfalfa Hay	210	210	143	157
Total	1,050	1,050	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050
Native Pasture	240	240	240	240

gated and dryland crops were produced at the allowable limits except for dryland millet. A closely competing irrigated crop was corn grain, which could replace durum.

The dryland farm plan with optimum management produced a net income of $10,600. Irrigating 270 acres increased net income approximately 122 per cent. Changes in the cropping pattern as a result of irrigation were identical under both management levels except for the production of a small acreage of irrigated flax and dryland millet. A closely competing irrigated crop was barley with a slight decrease in the flax price.

All-Crop Farm on High Available Water Capacity Soils

The dryland farm plan with normal management produced a net income of $32,700 while irrigating 270 acres increased net income approximately 13 per cent (Table 6). The dryland farm's net income with optimum management, $49,800, increased about 14 per cent when irrigation was included. Alfalfa hay, durum, and oil sunflowers under irrigation and dryland were at their rotational limits in all four farm situations. Irrigating 270 acres influenced the production of millet because of a shortage of planting labor. A closely competing irrigated crop was barley under both management levels.

TABLE 6. CROP ENTERPRISE COMBINATIONS PROVIDING HIGHEST PROFIT, HIGH AVAILABLE WATER CAPACITY SOILS, NO SPECIALTY CROP, WARWICK-McVILLE IRRIGATION AREA

	Dryland Only		Dryland-Irrigated	
	Normal Management	Optimum Management	Normal Management	Optimum Management
Net Income	$32,700	$49,800	$36,900	$56,800
Irrigated Crops (Acres)				
Sunflowers (Oil)			68	68
Durum			135	135
Flax			14	
Alfalfa Hay			53	67
Total			270	270
Dryland Crops (Acres)				
Sunflowers (Oil)	263	263	195	195
Durum	525	525	390	390
Flax	52	52	28	30
Alfalfa Hay	210	210	157	143
Millet			10	22
Total	1,050	1,050	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050
Native Pasture	240	240	240	240

Farm Production Alternatives on Low Available Water Capacity Soils

Many farmers in the Warwick-McVille irrigation area may want to produce certain crops and livestock enterprises not included in the most profitable farm plan. Farm plans including selected enterprises are provided in the following sections to provide guidance to these farmers. The influence of adding or eliminating certain crop and/or livestock enterprises is analyzed in this section. Low available water capacity soils under both management levels are included in the analysis. Similar information for the high available water capacity soils is covered in the next section.

All-Crop Farm With Cropping Alternatives

Normal Management

The basic crop farm plan includes all crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers. A discussion of the cropping pattern for the all-crop base model was presented in the previous section where dryland and irrigated operations were compared (Table 5).

Pinto Beans Added

The field bean market is highly volatilizable since price responds to a relatively small change in supply. Field beans, like other specialty crops, require additional capital investment for specialized planting and harvesting equipment.

The inclusion of pinto beans as an irrigated crop alternative increased net income on the all-crop farm 63 per cent compared to the basic crop farm plan (Table 7). Pinto beans replaced all the oil sunflower acreage and partially replaced irrigated alfalfa hay. Potential disease problems limited the production of pinto beans and durum to their rotational limits under irrigation. Dryland durum, oil sunflowers, and alfalfa hay also were produced at their rotational limits. A slight decrease in the price of durum would increase the acreage devoted to barley.

Navy Beans Added

Net income increased 91 per cent compared to the basic crop farm plan and 18 per cent compared to pinto beans on the crop farm when navy beans were included in the farm plan (Table 7). Cropland acreage did not change except for the substitution of navy for pinto beans. A closely competing irrigating crop for durum acreage was barley.

Confectionery Sunflowers Added

Confectionery sunflowers were excluded from the basic crop farm plan because they are a contract crop and have a more limited market than oil sunflowers. Including confectionery sunflowers as a cropping alternative increased net income about 29 per cent compared to the basic crop farm plan (Table 7). Cropping pattern changes were the substitution of confectionery sunflowers for oil sunflowers on both irrigated and dryland acreage. A closely competing irrigated crop for durum acreage was barley.

Optimum Management

Including pinto beans as a cropping alternative increased net income 34 per cent compared to the basic crop farm plan, adding navy beans increased net income 42 per cent, and the inclusion of confectionery sunflowers increased net income 12 per cent (Table 8). Irrigated cropping pattern changes included a substitution of field beans for sunflowers with a reduction in flax and alfalfa hay acreage. Dryland millet was not produced when field beans were included as a cropping alternative because the increased acreage in long season crops reduced the spring planting labor shortage. A closely competing irrigated crop for the flax acreage was barley.

TABLE 7. HIGHEST PROFIT COMBINATION OF CROP ENTERPRISES WITH SELECTED SPECIALTY CROP ALTERNATIVES, LOW AVAILABLE WATER CAPACITY SOILS, NORMAL MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan[a]	Pinto Beans Added	Navy Beans Added	Confection Sunflowers Added
Net Income	$7,000	$11,400	$13,400	$9,000
Irrigated Crops (Acres)				
Sunflowers (Oil)	68			
Pinto Beans		90		
Navy Beans			90	
Sunflowers (Confectionery)				68
Durum	135	135	135	135
Alfalfa Hay	67	45	45	67
Total	270	270	270	270
Dryland Crops (Acres)				
Sunflowers (Oil)	195	195	195	
Sunflowers (Confectionery)				195
Durum	390	390	390	390
Millet	52	30	30	52
Alfalfa Hay	143	165	165	143
Total	780	780	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050
Native Pasture	240	240	240	240

[a] All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

TABLE 8. HIGHEST PROFIT COMBINATION OF CROP ENTERPRISES WITH SELECTED SPECIALTY CROP ALTERNATIVES, LOW AVAILABLE WATER CAPACITY SOILS, OPTIMUM MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan[a]	Pinto Beans Added	Navy Beans Added	Confection Sunflowers Added
Net Income	$23,500	$31,400	$33,300	$26,300
Irrigated Crops (Acres)				
Sunflowers (Oil)	68			
Pinto Beans		90		
Navy Beans			90	
Sunflowers (Confectionery)				68
Durum	135	135	135	135
Flax	14	5	5	14
Alfalfa Hay	53	40	40	53
Total	270	270	270	270
Dryland Crop (Acres)				
Sunflowers (Oil)	195	195	195	
Sunflowers (Confectionery)				195
Durum	390	390	390	390
Flax	28	25	25	28
Millet	10			10
Alfalfa Hay	157	170	170	157
Total	780	780	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050
Native Pasture	240	240	240	240

[a] All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

Crop Farm With Livestock Alternatives

Normal Management

Not all farmers will want to produce the kind of livestock specified in the most profitable farm plan, but may not want to eliminate livestock completely. This section examines the influence on the basic crop farm's net income and cropping pattern when alternative livestock enterprises were included in the farm plan.

Fattened Hogs

Net income increased 51 per cent compared to the basic crop farm plan when home raised feeder pigs were fattened to slaughter weight (Table 9). The irrigated cropping pattern changed with a shift from alfalfa hay and some durum acreage to corn grain. The corn grain was utilized as feed for the swine enterprises (40 sows with two litters and 516 feeder pigs fattened to slaughter weight). Sixty-seven acres of dryland cropland were shifted from durum and millet to alfalfa hay.

Dairy

Net income increased approximately 49 per cent when a 75 head dairy herd was added to the crop base farm (Table 9). Both the irrigated and dryland cropping patterns changed drastically. Half of the irrigated acreage and approximately one-fourth of the dryland acres were utilized to produce feed grains and forages for the dairy herd. Dryland durum was produced on fallow due to a shortage of labor. Sixty-two per cent of the native pasture was utilized by the dairy herd.

Beef Cow Herd — Finish Calves

Net income increased approximately 31 per cent when a steer finishing enterprise was added to the basic crop farm plan (Table 9). The steers were home raised. All the irrigated cropland was utilized to produce feed and forages for the livestock enterprise. Dryland durum was produced on fallow due to a shortage of labor. The beef cow herd fully utilized the native pasture and required the diversion of 184 acres from cropland to pasture. Other cropping pattern changes were influenced by the need for additional pasture and other forages.

Beef Cow Herd — Sell Calves

Net income decreased approximately 11 per cent when a beef cow herd was added on the basic crop farm plan (Table 9). Net income decreased approximately one-third when the calves were not finished to market weight. Approximately two-thirds of the irrigated acreage was utilized to produce feed for the 329 beef cows. The beef cow herd fully utilized the native pasture and required a diversion of 270 acres of cropland to pasture. Other cropping changes were influenced by the need for additional pasture and other feed grains and forages.

Feeder Pigs

Raising feeder pigs decreased net income 21 per cent compared to the basic crop farm plan (Table 9). Approximately a 50 per cent increase in net income was realized by finishing the feeder pigs to market weight. The only change in the irrigated cropping pattern was a substitution of corn grain for alfalfa hay. Sunflowers, durum, and alfalfa hay were produced at their rotational limits.

Sheep

Approximately three-fourths of the irrigated cropland acres were utilized as feed grains and forages for the sheep enterprise (Table 9). Native pasture was fully utilized and required a diversion of 62 acres from cropland to pasture. Sunflowers, durum, and alfalfa were produced at their rotational limits. All feed grains and forages produced on the farm were consumed by the livestock enterprise.

Optimum Management

Net income increased 51 per cent when a dairy herd was added on the basic crop farm plan (Table 10). Irrigated corn grain and silage with dryland alfalfa hay provided the feed supply for the dairy herd. Irrigated and dryland sunflowers were produced at their rotational limits. A shortage of labor influenced winter rye production because of the different labor period requirements for planting and harvesting. One-half of the native pasture was utilized by the dairy herd with the remaining pasture leased out.

The hog enterprise, with the feeder pigs sold at 40 pounds, increased net income 12 per cent compared to the basic crop farm plan; while finishing the feeder pigs to slaughter weight increased net income 43 per cent (Table 10). The irrigated cropping pattern changed with an increase in the production of corn grain since the feeder pigs were finished to market weight and the production of irrigated alfalfa hay and durum was decreased. Irrigated and dryland sunflowers were produced at their rotational limits. The dryland cropping pattern changed with an increased production of dryland alfalfa hay to its rotational limit of one-fifth of the cropland acres.

Adding a beef cow herd to the basic crop farm plan increased net income 3 per cent while finishing the steers to slaughter weight increased net income 12 per cent compared to the basic crop farm plan (Table 10). The irrigated cropping pattern changed to provide additional feed grain and/or forages. The beef cow herd fully utilized the native pasture and required diversion of cropland to pasture. Other cropping changes were influenced by the need for additional pasture, feed, and other forages.

Net income for the basic crop farm plan decreased 4 per cent when sheep were included (Table 10). All irrigated cropland was used to produce forages of feed grains for the sheep flock. Native pasture was fully utilized and a diversion of 187 acres from cropland to pasture was required. Other cropping changes were influenced by the need for additional feed grains and forages.

TABLE 9. EFFECT OF ALTERNATIVE LIVESTOCK ENTERPRISES ON HIGHEST PROFIT COMBINATION OF CROP ENTERPRISES, LOW AVAILABLE WATER CAPACITY SOILS, NORMAL MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan[a]	Fattened Hogs	Dairy	Beef Cow Finish Calves	Beef Cow Sell Calves	Feeder Pigs	Sheep
Net Income	$7,000	$10,600	$10,400	$9,200	$6,200	$5,500	$-5,900
Irrigated Crops (Acres)							
Sunflowers (Oil)	68	68				68	68
Durum	135	105	135		93	135	
Alfalfa Hay	67		25(100)[b]	150(100)	87(100)	47	96(100)
Corn Grain		97(100)	75(100)	108(100)		20(100)	106(100)
Corn Silage			35(100)	12(100)	90(100)		
Total	270	270	270	270	270	270	270
Dryland Crops (Acres)							
Sunflowers (Oil)	195	195	41	22		195	195
Durum	390	358		171		390	390
Millet	52	17				32	19
Alfalfa Hay	143	210	185(84)	60(44)	123	163	114(100)
Barley			15(100)				
Tame Grass Pasture				184(100)	270(100)		62(100)
Durum on Fallow			260	146	160		
Fallow			260	146	160		
Winter Rye			19				
Oats Grain				51(100)	67(100)		
Total	780	780	780	780	780	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Native Pasture	240	240	240(62)	240(100)	240(100)	240	240(100)
Livestock (Head)							
Sow With Two Litters		40				40	
Feeder Pigs		516					
Dairy			75				
Beef Cow				249	329		
Feeder Steers				98			
Sheep							995

[a]All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.
[b]( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.

TABLE 10. EFFECT OF ALTERNATIVE LIVESTOCK ENTERPRISES ON HIGHEST PROFIT COMBINATION OF CROP ENTERPRISES, LOW AVAILABLE WATER CAPACITY SOILS, OPTIMUM MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan[a]	Dairy	Fattened Hogs	Feeder Pigs	Beef Cow Finish Calves	Beef Cow Sell Calves	Sheep
Net Income	$23,500	$35,500	$33,500	$26,300	$26,300	$24,100	$22,600
Irrigated Crops (Acres)							
Sunflowers (Oil)	68	68	68	68	68	68	
Durum	135	129	115	135	106	133	
Flax	14						
Alfalfa Hay	53			52			182(100)[b]
Corn Grain		51(100)	87(100)	15(100)	53(100)		88(100)
Corn Silage		22			43(100)	69(100)	
Total	270	270	270	270	270	270	270
Dryland Crops (Acres)							
Sunflowers (Oil)	195	120	195	195		47	195
Durum	390	225	360	390	350	350	256
Flax	28			27			
Alfalfa Hay	157	210(85)	210	159	210(100)	210(46)	28(100)
Millet	10		15	9			
Barley					92(100)	32(100)	187(100)
Alfalfa-Brome Pasture					96(100)	141(100)	114(100)
Winter Rye		225[c]			32		
Total	780	780	780	780	780	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Native Pasture	240	240(50)	240	240	240(100)	240(100)	240(100)
Livestock (Head)							
Sow With Two Litters			40	40			
Feeder Pigs			671				
Sheep							1,668
Dairy		67					
Beef Cow					207	263	
Feeder Steer					94		

[a]All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.
[b]( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.
[c]A large acreage of winter rye was produced because of a shortage of spring planting labor.

Crop and Livestock Farm With Purchased Feed and/or Livestock Alternatives

The previous analysis examined the highest profit combination of cropping alternatives with selected livestock enterprises assuming no purchased feed and/or feeder livestock. Some livestock farmers in the Warwick-McVille irrigation area will be willing to purchase feed or livestock, so the model farm was analyzed when feed and/or livestock were purchased. The price difference between purchased and home-raised feed and/or livestock is equal to the shipping, marketing, and handling costs. Refer to page 7 (Table 1) for purchased prices of feed and livestock. This section evaluates the competition for the farm resources when feed and/or livestock were purchased.

Normal Management

Purchased Feed

When feed was purchased, net income increased 7 per cent over the farm plans where feed was produced (Table 11). The irrigated cropping pattern changed to less feed grains and an increase in forage production. Irrigated sunflowers were produced at their rotational limit and an increase in the irrigated durum production occurred. Dryland oats grain was not produced since it now could be purchased. Dryland tame grass hay was produced because of different labor periods utilized to harvest the hay. Winter rye acreage also increased because of the different labor periods utilized for planting and harvesting. No changes occurred in the swine enterprises. The size of the beef cow herd decreased along with a slight decrease in the size of the finishing steer enterprise; fewer calves were sold as feeders instead of being finished to slaughter weight. The additional labor released by the decrease in the size of the beef cow herd, finishing steer enterprise, and increased winter rye production was used to increase the size of the dairy herd.

Purchase Feed and Livestock

Allowing both feed and feeder livestock to be purchased increased net income 93 per cent over the crop and livestock base farm plan (Table 11). The irrigated cropping pattern changed with increased production of forages and a decrease in feed grain production since a large percentage of feed grain was purchased. Size of the finishing feeder pig enterprise increased to its resource limitation with the purchase of additional feeder pigs. The beef cow and dairy herd operations were replaced by a steer finishing enterprise; the steers were purchased as either calves or backgrounded calves. Shortages of labor influenced the increased production of winter rye.

Optimum Management

Net income increased 5 per cent compared to the crop and livestock base farm plan when feed was purchased (Table 12). Irrigated feed grains produced decreased with a similar increase in irrigated durum acreage. Dryland barley was not produced since barley now could be purchased. Irrigated and dryland sunflowers and alfalfa hay were produced at their rotational limits. The size of the sheep enterprise increased to its resource limitation along with a slight decrease in the dairy herd.

TABLE 11. EFFECT OF PURCHASING FEED AND/OR LIVESTOCK ON HIGHEST PROFIT COMBINATION OF CROP AND LIVESTOCK ENTERPRISES, LOW AVAILABLE WATER CAPACITY SOILS, WARWICK-McVILLE IRRIGATION AREA, NORMAL MANAGEMENT

	Basic Crop and Livestock Farm Plan[a]	Purchase Feed	Purchase Feed and Livestock
Net Income	$14,700	$15,800	$28,400
Irrigated Crops (Acres)			
Sunflowers (Oil)		68	56
Durum	37	58	
Alfalfa Hay	45(100)[b]	54(100)	155(42)
Corn Grain	165(100)	48(100)	19(100)
Corn Silage	23(100)	42(100)	40(100)
Total	270	270	270
Dryland Crops (Acres)			
Alfalfa Hay	165(62)	134	55
Tame Grass Hay		23(100)	
Durum on Fallow	260	260	260
Fallow	260	260	260
Winter Rye	85	103	205
Oats Grain	10(100)		
Total	780	780	780
Total Cropland Acres	1,050	1,050	1,050
Native Pasture	240(100)	240(94)	240
Livestock (Head)			
Sow With Two Litters	40	40	40
Feeder Pigs	516	516	672
Beef Cow	83	44	
Feeder Steers	20	17	495
Dairy	44	47	
Feed and Livestock Purchased			
Oats (Bushels)		199	
Barley (Bushels)		9,335	40,101
Feeder Pigs (Hundredweight)			62
Steer Calf (Hundredweight)			2,016
Backgrounded Steer Calf (Hundredweight)			81

[a]All crop and livestock enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.
[b]( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.

Purchased feed and livestock increased net income 10 per cent compared to the crop and livestock base farm plan (Table 12). Irrigated corn was harvested as grain rather than silage. Shortage of labor influenced the production of winter rye because of the different labor needs for planting and harvesting. Size of the feeder pig enterprise increased slightly to its resource limitation. The size of the sheep enterprise decreased and a feeder steer enterprise was added.

Other Alternatives

This section analyzes the effect of modifying certain model farm assumptions on net income and enterprise organization. Only optimum management was considered for this section since it was assumed that, initially, only farmers with relatively high managerial ability would produce sugarbeets or potatoes or rent additional irrigated land.

Other Specialty Crops

Specialty crops, such as sugarbeets or potatoes, add considerably to net income. Each of these crops has unique marketing problems in addition to a higher capital investment per acre.

Sugarbeet Production

Initially, sugarbeets are not expected to be grown in the Warwick-McVille irrigation area due to the lack of processing plants. The additional capital investment in specialty equipment would be approximately $29,000 or $320 per acre.

Net income increased approximately 9 per cent when sugarbeets were produced on the basic crop farm (Table 13). Sugarbeets replaced flax, alfalfa hay, and part of the irrigated durum acreage. The acreage of dryland millet increased because of a shortage of spring labor even though approximately 3½ hours per acre of additional hired seasonal labor were employed in the production of sugarbeets. Irrigated and dryland sunflowers and alfalfa hay were produced at their rotational limits. A closely competing irrigated crop was barley.

Potato Production

It was assumed that farmers would not produce both sugarbeets and potatoes because of the large capital investment necessary for specialty equipment relative to the size of the model farm. Capital investment for potato equipment was $26,500 or approximately $295 per acre. Potato production increased net income 126 per cent

TABLE 12. EFFECT OF PURCHASING FEED AND/OR LIVESTOCK ON HIGHEST PROFIT COMBINATION OF CROP AND LIVESTOCK ENTERPRISES, LOW AVAILABLE WATER CAPACITY SOILS, OPTIMUM MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop and Livestock Farm Plan [a]	Purchase Feed	Purchase Feed and Livestock
Net Income	$39,500	$41,400	$43,500
Irrigated Crops (Acres)			
Sunflowers (Oil)	68	68	68
Durum	37	134	135
Corn Grain	134(100) [b]	39(100)	30(100)
Alfalfa Hay	20(100)	20(100)	
Corn Silage	11(100)	10(100)	37(100)
Total	270	270	270
Dryland Crops (Acres)			
Sunflowers (Oil)	124	173	4
Durum	165	208	283
Alfalfa Hay	190(100)	19(100)	210(81)
Winter Rye	233 [c]	208 [c]	283 [c]
Barley	68(100)		
Total	780	780	780
Total Cropland Acres	1,050	1,050	1,050
Native Pasture	240(100)	240(100)	240(32)
Livestock (Head)			
Sow With Two Litters	40	40	40
Feeder Pigs	671	671	672
Sheep	487	500	382
Dairy	32	30	
Feeder Steers			316
Feed and Livestock Purchased			
Barley (Bushels)		12,467	28,968
Feeder Pigs (Pounds)			48
Steer Calf (Hundredweight)			1,322

[a] All crop and livestock enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

[b] ( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.

[c] A large acreage of winter rye was provided because of a shortage of spring planting labor.

TABLE 13. EFFECT OF SELECTED SPECIALTY CROPS ON HIGHEST PROFIT COMBINATION OF CROP ENTERPRISES, LOW AVAILABLE WATER CAPACITY SOILS, OPTIMUM MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan [a]	Sugarbeets Added	Potatoes Added
Net Income	$23,500	$25,500	$53,100
Irrigated Crops (Acres)			
Sunflowers (Oil)	68	68	
Sugarbeets		90	
Potatoes			90
Durum	135	112	135
Flax	14		5
Alfalfa Hay	53		40
Total	270	270	270
Dryland Crops (Acres)			
Sunflowers (Oil)	195	195	195
Durum	390	316	390
Flax	28		25
Alfalfa Hay	157	210	170
Millet	10	59	
Total	780	780	780
Total Cropland Acres	1,050	1,050	1,050
Native Pasture	240	240	240

[a] All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

compared to the basic crop farm plan (Table 13). Potatoes, durum, flax, and alfalfa hay were produced on the irrigated cropland. The dryland cropping pattern changed slightly with an increase in the acreage producing alfalfa hay. Additional seasonal labor (1.2 hours per acre) was hired to plant and harvest potatoes. A closely competing crop for the irrigated flax acreage was barley.

Renting Additional Irrigated Land

One of the basic assumptions of the linear programming model and the model farm was that the farmer was married; therefore, the farmer and his spouse could each own 160 acres of irrigated land, or a total of 320 acres under the Bureau of Reclamation rules. Two center pivots were used to irrigate 270 of 320 acres of the available irrigated land. There should be irrigated land available that could be rented since not all farmers in the Warwick-McVille irrigation area will want to irrigate. The profitability of irrigation may encourage some farmers to invest all their resources in irrigation. The following analysis examines the profitability of renting additional irrigated land at a cost of $50 per acre.

All-Crop Farm

Net income increased approximately 38 per cent compared to the basic crop farm plan (Table 14). Irrigated acreage increased from 270 to 612 or 342[4] additional acres were rented. All irrigated crops produced on the model farm increased in acreage except for flax which was replaced by corn grain. The dryland cropping pattern also changed drastically because of labor shortages with increased production of millet and winter rye.

Crop and Livestock Farm

Irrigated acreage increased from 270 to 643 acres, increasing net income 24 per cent over the basic crop and livestock farm (Table 14). Size of the sheep enterprise increased while the size of the dairy enterprise decreased, providing some of the labor needed for the extra irrigated acres. Increased corn grain acreage and lower feed grain requirements by the livestock enterprise influenced the production of dryland barley. This provided additional acreage for dryland alfalfa hay and durum production.

TABLE 14. EFFECT OF RENTING ADDITIONAL IRRIGATED LAND ON HIGHEST PROFIT COMBINATION OF CROP AND/OR LIVESTOCK ENTERPRISES, LOW AVAILABLE WATER CAPACITY SOILS, OPTIMUM MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan[a]	Expanded Crop Farm	Basic Crop and Livestock Farm Plan[b]	Expanded Crop and Livestock Farm
Net Income	$23,500	$32,500	$39,500	$49,100
Irrigated Crops (Acres)				
Sunflowers (Oil)	68	153	68	161
Durum	135	306	37	321
Flax	14			
Alfalfa Hay	53	75	20(100)[c]	11(100)
Corn Grain		78	134(100)	139(100)
Corn Silage			11(100)	11(100)
Total	270	612	270	643
Dryland Crops (Acres)				
Sunflowers (Oil)	195	54	124	62
Durum	390	132	165	
Summer Fallow				66
Fallow				66
Flax	28			
Alfalfa Hay	157	203	190(100)	293(57)
Millet	10	259		153
Winter Rye		132[d]	233[d]	136[d]
Barley			68(100)	4(100)
Total	780	780	780	780
Total Cropland Acres	1,050	1,382	1,050	1,257
Native Pasture	240	240	240(100)	240(89)
Livestock Head				
Sow With Two Litters			40	40
Feeder Pigs			671	671
Sheep			487	500
Dairy			32	
Beef Cow				35
Feeder Steers				16

[a] All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

[b] All crop and livestock enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

[c] ( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.

[d] A large acreage of winter rye was produced because of a shortage of spring planting labor.

[4] Irrigated land was not rented in any given number of acres (i.e. quarters); therefore, the odd number of acres rented.

Farm Production Alternatives on High Available Water Capacity Soils

This section analyzes the effect of adding or eliminating certain crop and/or livestock enterprises on the cropping pattern and net income from soils with high available water capacity. Readers are referred to the previous section for a more detailed explanation of why certain crop and/or livestock enterprises were added or eliminated from the analysis.

All-Crop Farm With Cropping Alternatives

The basic crop farm plan includes all crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers. A discussion of the cropping patterns for the basic crop farm plan was presented in an earlier section where dryland and irrigation operations were compared (page 9).

Normal Management

Including pinto beans, navy beans, and confectionery sunflowers as cropping alternatives increased net income 17, 22, and 9 per cent, respectively, compared to the basic crop farm plan (Table 15). Producing field beans changed the irrigated cropping pattern slightly by diverting 22 acres to specialty crops with a similar decrease in flax and alfalfa hay acreage. The dryland cropping pattern changed with increased production of alfalfa to its rotational limit reducing millet and flax acreage. The only irrigated and dryland cropping pattern change when confectionery sunflowers were produced on the crop base farm was a substitution of confectionery for oil sunflowers. A closely competing crop for the irrigated flax acreage was barley for corn.

Optimum Management

Net income increased 15, 19, and 7 per cent, respectively, when pinto beans, navy beans, and confectionery sunflowers were produced on the basic crop farm (Table 16). A closely competing crop that could be grown with only a slight decrease in net income was irrigated barley replacing alfalfa hay.

Crop Farm With Livestock Alternatives

This section examines the influence of the basic crop farm's net income and cropping pattern when alternative livestock enterprises were included in the farm plan.

Normal Management

Producing feeder pigs on the basic crop farm by adding the sow and two litter enterprise decreased net income 4 per cent while finishing the feeder pigs to market weight increased net income 11 per cent (Table 17). The major changes in the cropping patterns occurred because of the increased feed grain (corn grain) requirements. Net income increased 10 per cent compared to the basic crop farm plan when a dairy enterprise was included on the farm (Table 17). The dryland and irrigated cropping patterns changed due to an increase in the acreage devoted to irrigated and dryland corn grain and/or silage which were used as livestock feed. Including a beef cow enterprise on the basic crop farm decreased net income approximately 8 per cent, but finishing the steers to market weight provided approximately the same income. Adding a sheep enterprise reduced net income approximately 30 per cent (Table 17). Income loss from changes in cropping patterns and the shift of cropland to pasture was not offset by income from the livestock enterprises.

TABLE 15. HIGHEST PROFIT COMBINATION OF CROP ENTERPRISES WITH SELECTED SPECIALTY CROP ALTERNATIVES, HIGH AVAILABLE WATER CAPACITY SOILS, NORMAL MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan[a]	Pinto Beans Added	Navy Beans Added	Confection Sunflowers Added
Net Income	$36,900	$43,300	$45,200	$40,100
Irrigated Crops (Acres)				
Sunflowers (Oil)	68			
Pinto Beans		90		
Navy Beans			90	
Sunflowers (Confectionery)				68
Durum	135	135	135	135
Flax	14	5	5	14
Alfalfa Hay	53	40	40	53
Total	270	270	270	270
Dryland Crops (Acres)				
Sunflowers (Oil)	195	195	195	
Sunflowers (Confectionery)				195
Durum	390	390	390	390
Flax	28	25	25	28
Millet	10			10
Alfalfa Hay	157	170	170	157
Total	780	780	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050
Native Pasture	240	240	240	240

[a] All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

TABLE 16. HIGHEST PROFIT COMBINATION OF CROP ENTERPRISES WITH SELECTED SPECIALTY CROP ALTERNATIVES, HIGH AVAILABLE WATER CAPACITY SOILS, OPTIMUM MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan [a]	Pinto Beans Added	Navy Beans Added	Confection Sunflowers Added
Net Income	$56,800	$65,600	$67,500	$60,800
Irrigated Crops (Acres)				
Sunflowers (Oil)	68			
Pinto Beans		90		
Navy Beans			90	
Sunflowers (Confectionery)				68
Durum	135	135	135	135
Alfalfa Hay	67	45	45	67
Total	270	270	270	270
Dryland Crops (Acres)				
Sunflowers (Oil)	195	195	195	
Sunflowers (Confectionery)				195
Durum	390	390	390	390
Flax	30	26	26	30
Alfalfa Hay	143	165	165	143
Millet	22	4	4	22
Total	780	780	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050
Native Pasture	240	240	240	240

[a] All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

TABLE 17. EFFECT OF ALTERNATIVE LIVESTOCK ENTERPRISES ON HIGHEST PROFIT COMBINATION OF CROP ENTERPRISES, HIGH AVAILABLE WATER CAPACITY SOILS, NORMAL MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan [a]	Fattened Hogs	Dairy	Beef Cow Sell Calves	Beef Cow Finish Calves	Feeder Pigs	Sheep
Net Income	$36,900	$40,900	$40,600	$34,000	$37,000	$35,500	$25,800
Irrigated Crops (Acres)							
Sunflowers (Oil)	68	68	27	29		68	68
Durum	135	120	135	105	135	135	104
Flax	14						
Alfalfa Hay	53		58(100)[b]	136(100)	45(100)	50	31(100)
Corn Grain		82(100)	50(100)		78(100)	17(100)	67(100)
Corn Silage					12(100)		
Total	270	270	270	270	270	270	270
Dryland Crops (Acres)							
Sunflowers (Oil)	195	172	192	179		195	195
Durum	390	390	390	390	390	390	390
Flax	28					26	
Alfalfa Hay	157	210	152	74	165(11)	160	179(74)
Millet	10	8				9	
Barley				21(100)	18(100)		
Alfalfa-Brome Pasture				116(100)	91(100)		16(100)
Corn Silage			46(100)		116(100)		
Total	780	780	780	780	780	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Native Pasture	240	240	240(47)	240(100)	240(100)	240	240(100)
Livestock (Head)							
Sow With Two Litters		40				40	
Feeder Pigs		516					
Dairy			57				
Sheep							745
Beef Cow				251	214		
Feeder Steer					84		

[a] All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.
[b] ( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.

Optimum Management

Net income increased 20, 17, 5, and 3 per cent, respectively, compared to the basic crop farm plan when dairy, fattened hogs, feeder pigs, or a feeder cattle enterprise was included on the farm (Table 18). Including a sheep or beef cow enterprise decreased net income 1 and 2 per cent, respectively. Both irrigated and dryland cropping patterns were influenced by the need for livestock feed. More feed grain acreage was required for the swine, dairy, and feeder cattle enterprises while more acres of forage and pasture were required by the beef cow and sheep enterprises.

Crop and Livestock Farm With Purchased Feed and/or Livestock Alternatives

The previous analyses examined the highest profit combination with and without livestock. This section examines the resource allocation between all crop and livestock enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers when feed and/or livestock were purchased.

Normal Management

Net income increased 1 per cent when feed was purchased while purchasing both feed and livestock increased net income 17 per cent (Table 19). Irrigated and dryland cropping patterns changed slightly with a shift in acreage from feed grains to sunflowers. Purchasing feed and livestock changed the cropping and livestock patterns. A feeder cattle enterprise replaced the dairy enterprise, requiring additional forage and labor, influencing the production of winter rye.

Optimum Management

Purchasing feed slightly increased net income compared to the basic crop and livestock farm plan (Table 20). Fewer acres of feed grains were required to support the livestock enterprise allowing additional production of sunflowers. Additional feed supplies, increased production of long-season crops, and a reduction in the size of the dairy herd provided the needed resources to increase the size of the feeder pig enterprise. The plan allowing purchased feed and livestock provided approximately the same income as the basic crop and livestock farm plan (Table 20). The lower net income when both feed and livestock were purchased compared to only purchased feed is due to increased fixed costs associated with the change in the size and type of livestock enterprises. Changes in dryland cropping pattern were influenced by the increased forage requirements of the feeder cattle enterprise which replaced the dairy enterprise.

Other Alternatives

This section analyzes the effect on net income and enterprise organization of modifying certain model farm assumptions. Only optimum management was considered for these options. The results will provide guidance to the farmer who wishes to consider producing potatoes or sugarbeets or renting additional irrigated land.

Specialty Crops

Specialty crops, such as potatoes and sugarbeets, add considerably to net income. Each of the crops has unique

TABLE 18. EFFECT OF ALTERNATIVE LIVESTOCK ENTERPRISES ON HIGHEST PROFIT COMBINATION OF CROP ENTERPRISES, HIGH AVAILABLE WATER CAPACITY SOILS, OPTIMUM MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan [a]	Dairy	Fattened Hogs	Feeder Pigs	Beef Cow Finish Calves	Sheep	Beef Cow Sell Calves
Net Income	$56,800	$67,900	$66,400	$59,700	$58,400	$56,200	$55,600
Irrigated Crops (Acres)							
Sunflowers (Oil)	68	68	68	68	65		68
Durum	135	135	121	135	135		135
Alfalfa Hay	67	27(100) [b]		54	3(100)	163(100)	53(100)
Corn Grain		40(100)	81(100)	13(100)	67(100)	107(100)	
Corn Silage							14(100)
Total	270	270	270	270	270	270	270
Dryland Crops (Acres)							
Sunflowers (Oil)	195	150	161	195		195	55
Durum	390	390	390	390	390	390	390
Flax	30	23	19	28		45	
Alfalfa Hay	143	183(28)	210	156	207(38)	46(100)	157
Millet	22			11			
Barley					12(100)	26(100)	15(100)
Alfalfa-Brome Pasture					63(100)	78(100)	96(100)
Corn Silage		34(100)			108(100)		67(100)
Total	780	780	780	780	780	780	780
Total Cropland Acres	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Native Pasture	240	240(42)	240	240	240(100)	240(100)	240(100)
Livestock (Head)							
Sow With Two Litters			40	40			
Feeder Pigs			671				
Sheep						1,628	
Dairy		57					
Beef Cow					199		257
Feeder Steer					90		

[a] All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.
[b] ( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.

TABLE 19. EFFECT OF PURCHASING FEED AND/OR LIVESTOCK ON HIGHEST PROFIT COMBINATION OF CROP AND LIVESTOCK ENTERPRISES, HIGH AVAILABLE WATER CAPACITY SOILS, NORMAL MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop and Livestock Farm Plan [a]	Purchase Feed	Purchase Feed and Livestock
Net Income	$46,000	$46,500	$54,000
Irrigated Crops (Acres)			
Sunflowers (Oil)		6	
Durum	135	135	135
Corn Grain	98(100) [b]	90(100)	69(100)
Alfalfa Hay	37(100)	39(100)	48(100)
Corn Silage			18(100)
Total	270	270	270
Dryland Crops (Acres)			
Sunflowers (Oil)	139	187	
Durum	390	390	390
Alfalfa Hay	173(4)	171	162
Winter Rye			208
Corn Silage	32(100)	32(100)	20(100)
Barley	46(100)		
Total	780	780	780
Total Cropland Acres	1,050	1,050	1,050
Native Pasture	240(33)	240(32)	240
Livestock (Head)			
Sow With Two Litters	40	40	40
Feeder Pigs	516	516	672
Dairy	40	39	
Feeder Steer			389
Feed and Livestock Purchased			
Barley (Bushels)		2,402	28,155
Feeder Pigs (Hundredweight)			62
Steer Calf (Hundredweight)			1,628

[a] All crop and livestock enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.
[b] ( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.

marketing problems in addition to a higher capital investment per acre.

Sugarbeet production increased the model farm's net income 4 per cent and producing potatoes increased net income 59 per cent compared to the basic crop farm plan (Table 21). Irrigated potatoes, sugarbeets, sunflowers and/or durum, and dryland sunflowers and durum were produced at their rotational limits. The dryland cropping pattern was influenced by the production of alfalfa hay to its rotational limit of one-fifth of the total cropland acres. Alfalfa hay could be replaced by irrigated barley with only a slight decrease in net income.

Renting Additional Land

The following analysis examines the profitability of renting additional irrigated land at a cost of $50 per acre. Net income for the basic crop farm plan increased 15 per cent when 311 additional irrigated acres were rented (Table 22). Irrigated crops were sunflowers, durum, alfalfa hay, and corn grain. Winter rye and millet were produced on dryland acreage because of the shortage of labor.

Net income for the crop and livestock farm increased 12 per cent when an additional 261 irrigated acres were rented at $50 per acre. Labor shortages caused a drastic change in the dryland cropping pattern. No dryland barley was produced when additional irrigated land was rented because of increased irrigated corn grain production. Winter rye was produced on dryland acreage because of peak season labor shortages. The size of the dairy enterprise decreased providing labor for additional irrigated land and the expansion of the feeder pig enterprise.

TABLE 20. EFFECT OF PURCHASING FEED AND/OR LIVESTOCK ON HIGHEST PROFIT COMBINATION OF CROP AND LIVESTOCK ENTERPRISES, HIGH AVAILABLE WATER CAPACITY SOILS, OPTIMUM MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop and Livestock Farm Plan [a]	Purchase Feed	Purchase Feed and Livestock
Net Income	$72,900	$73,800	$72,700 [b]
Irrigated Crops (Acres)			
Sunflowers (Oil)	28	68	68
Durum	135	135	135
Corn Grain	107(100) [c]	67(100)	67(100)
Total	270	270	270
Dryland Crops (Acres)			
Sunflowers (Oil)	132	149	113
Durum	390	390	390
Flax		18	18
Alfalfa Hay	210(83)	210(77)	210(70)
Corn Silage	16(100)	13(100)	49(100)
Barley	32(100)		
Total	780	780	780
Total Cropland Acres	1,050	1,050	1,050
Native Pasture	240(99)	240(95)	240(78)
Livestock (Head)			
Sow With Two Litters	40	40	40
Feeder Pigs	518	671	672
Sheep	500	500	500
Dairy	27	22	
Feeder Steer			177
Feed and Livestock Purchased			
Barley (Bushels)		7,848	17,852
Feeder Pigs (Pounds)			48
Steer Calf (Hundredweight)			1,160

[a] All crop and livestock enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

[b] Lower net income is due to increased fixed cost associated with changes in size and type of livestock enterprises.

[c] ( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.

TABLE 21. EFFECT OF SELECTED SPECIALTY CROPS ON HIGHEST PROFIT COMBINATION OF CROP ENTERPRISES, HIGH AVAILABLE WATER CAPACITY SOILS, OPTIMUM MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan [a]	Sugarbeets Added	Potatoes Added
Net Income	$56,800	$59,200	$90,500
Irrigated Crops (Acres)			
Sunflowers (Oil)	68	68	
Durum	135	76	135
Alfalfa Hay	67	36	45
Sugarbeets		90	
Potatoes			90
Total	270	270	270
Dryland Crops (Acres)			
Sunflowers (Oil)	195	195	195
Durum	390	390	390
Flax	30		26
Alfalfa Hay	143	174	165
Millet	22	21	4
Total	780	780	780
Total Cropland Acres	1,050	1,050	1,050
Native Pasture	240	240	240

[a] All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

TABLE 22. EFFECT OF RENTING ADDITIONAL IRRIGATED LAND ON HIGHEST PROFIT COMBINATION OF CROP AND/OR LIVESTOCK ENTERPRISES, HIGH AVAILABLE WATER CAPACITY SOILS, OPTIMUM MANAGEMENT, WARWICK-McVILLE IRRIGATION AREA

	Basic Crop Farm Plan[a]	Expanded Crop Farm	Basic Crop and Livestock Farm Plan[b]	Expanded Crop and Livestock Farm
Net Income	$56,800	$65,400	$72,900	$81,600
Irrigated Crops (Acres)				
Sunflowers (Oil)	68	145	28	133
Durum	135	130	135	164
Alfalfa Hay	67	134		68(95)[c]
Corn Grain		172	107(100)	166(76)
Total	270	581	270	531
Dryland Crops (Acres)				
Sunflowers (Oil)	195		132	
Durum	390	346	390	353
Flax	30	61		14
Alfalfa Hay	143	138	210(83)	194
Millet	22	200[d]		207[d]
Winter Rye		35		
Corn Silage			16(100)	12(100)
Barley			32(100)	
Total	780	780	780	780
Total Cropland Acres	1,050	1,299	1,050	1,267
Native Pasture	240	240	240(99)	240(100)
Livestock (Head)				
Sow With Two Litters			40	40
Feeder Pigs			518	671
Sheep			500	500
Dairy			27	5
Beef Cow				27
Feeder Steers				7

[a] All crop enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

[b] All crop and livestock enterprises except potatoes, sugarbeets, field beans, and confectionery sunflowers were included.

[c] ( ) Indicates per cent of crop utilized as livestock feed with remaining per cent marketed.

[d] A large acreage of millet was produced because of a shortage of spring planting labor.

Farm Enterprise Summary

The purpose of the study was to determine the highest profit combination of irrigated crops, dryland crops, and livestock enterprises for the Warwick-McVille section of the Garrison Diversion Irrigation Project. A 1,340-acre model farm was developed containing 1,050 acres of cropland, 240 acres of native pasture, and 50 acres of farmstead and wasteland. Two center pivot irrigation systems were used to irrigate 270 acres. Labor was provided by the farmer, a school age child, and a full-time hired man. Product prices were established to represent normal commodity price relationships that are considered to be relevant for the long-term planning involved in the Garrison Diversion Irrigation Project. A total of 22 irrigated and 31 dryland cropping activities and 58 livestock activities were included as alternatives. The analysis includes both normal and optimum management levels and soils with low and high available water capacity. Major emphasis was placed on farms dominated by soils with low available water capacity and operated at the normal management level.

A summary of net incomes for the different crop and livestock alternatives is given in Table 23. Differences in net income between management levels are due largely to increased productivity of crop and livestock enterprises. Profit maximizing farm plans with inclusion of specialty crops are provided for guidance to interested farmers. Potatoes, sugarbeets, field beans, and confectionery sunflowers are considered specialty crops in this report. Some of the reasons for excluding specialty crops from the farm plan were: 1) the limited number of processing plants presently available for handling specialty crops, 2) the price effect of additional production on the market, and 3) the additional capital investment for specialized equipment. Some specialty crops do add considerably to the income, but may also increase risk due to higher capital investments needed and often less stable markets. Sugarbeets are a contract crop not available to early irrigators; and field beans, confectionery sunflowers, and potato markets also may be somewhat limited.

Profit maximizing farm plans without livestock enterprises were analyzed since not all farmers will want to produce livestock. Higher net incomes for model farms with livestock are due to full utilization of off-season labor. Profit maximizing farm plans for different livestock alternatives were analyzed to provide guidance to farmers. The influence of renting additional irrigated land was analyzed to determine its effect on crop and livestock production patterns and resulting net income. The crop and livestock enterprises that entered the profit maximizing farm plans are discussed on the following page.

TABLE 23. NET INCOME SUMMARY FOR CROP AND LIVESTOCK ALTERNATIVES, WARWICK-McVILLE IRRIGATION AREA

	Available Soil Water Capacity			
	Low		High	
	Normal Management	Optimum Management	Normal Management	Optimum Management
All Crop Farm With Specialty Crop Alternatives				
Dryland Only	$ 1,100	$10,600	$32,700	$ 49,800
Dryland and Irrigated				
All Crop Base Farm	7,000	23,500	36,900	56,800
Pinto Beans Added	11,400	31,400	43,300	65,600
Navy Beans Added	13,400	33,300	45,200	67,500
Confectionery Sunflowers Added	9,000	26,300	40,100	60,800
Sugarbeets Added		25,500		59,200
Potatoes Added		73,600		112,400
Crop Farm With Livestock Alternatives				
Fattened Hogs Added	10,600	33,500	40,900	66,400
Dairy Added	10,400	35,400	40,600	67,900
Feeder Cattle Added	9,200	26,300	37,000	58,400
Beef Cow Added	6,200	24,100	34,000	55,600
Feeder Pigs Added	5,500	26,300	35,500	59,700
Sheep Added	-5,900	22,600	25,800	56,200
Crop and Livestock Farm With Livestock Alternatives				
Dryland Only	4,700	27,800	38,700	68,300
Dryland and Irrigated Crop and Livestock Base Farm	14,700	39,400	46,000	72,900
Purchase Feed	15,800	41,600	46,500	73,800
Purchase Feed and Livestock	28,400	44,900	54,000	72,700
Renting Additional Land				
Crop and Livestock Farm		44,400		78,200
All-Crop Farm		28,000		61,200

NOTE: For details refer to Tables 3 through 22.

Irrigated Crop Enterprises

Irrigated crop enterprises entering the profit maximization farm plan were influenced by commodity prices, cost of production, feed grain and forage requirements for the livestock enterprises, specialty crop produced, rotational limitations, and availability of labor.

Hay

A combination of alfalfa-brome or straight alfalfa was considered under a number of different rotations with or without a nurse crop. Irrigated hay was a profit maximizing land use under both management levels and for both soil textural groups. The type and size of the livestock enterprises influenced the amount of irrigated hay sold. Irrigated hay production for cash sale came into the farm plan for both management levels and soil textural groups when livestock enterprises were excluded.

Wheat

Wheat could be produced either as durum or hard red spring wheat. Durum was profitable for both management levels and soil textural groups when no livestock were produced. Durum usually was produced at its rotational limit of one-half the irrigated acreage when no livestock enterprise alternatives were included on the model farm. Size and type of livestock enterprises influenced the production of durum because of acreage demands for feed grains, forages, and/or pasture. Hard red spring wheat was not included in any cropping pattern but could be substituted for durum with only minor change in the profitability of the farm plan.

Corn

Corn could be harvested as grain or silage. It was part of the cropping pattern when livestock enterprises were included; but the size and type of livestock enterprise influenced acreage and harvest method. Corn grain was included in the farm plan under optimum management when additional irrigated acres were rented.

Sunflowers

Oil and confectionery sunflowers were included as enterprise alternatives. Sunflowers were profitable for both management levels and soil textural groups when other specialty crops were not included as enterprise alternatives. Sunflower acreage was influenced by the size and type of livestock enterprises. Sunflower production was restricted to once every four years because of rotational considerations.

Field Beans

Both pinto and navy beans were included as enterprise alternatives. Field beans were profitable under both management levels and for both soil textural groups. Rotational considerations permitted field beans to be produced on only one-third of the irrigated land.

Potatoes

Farm plans, including late potatoes, were the most profitable in all the farm situations. Rotational considerations limited potatoes to one-third of the irrigated acreage.

Sugarbeets

Sugarbeets were profitable under optimum management for both soil textural groups. Only one-third of the irrigated land was allowed to be used for sugarbeets because of rotational limitations. Sugarbeet production in the Warwick-McVille irrigation area is not presently feasible because of the lack of processing facilities.

Other Irrigated Crops

Alfalfa-brome pasture, barley, and oats were the only irrigated crop enterprises not included in any cropping pattern. Flax was produced under normal management on high available water capacity soils and under optimum management on low available water capacity soils when no livestock enterprises were included in the farm plan.

Dryland Crop Enterprises

Dryland cropping patterns were influenced by the irrigated crops produced; especially those used for livestock feed, size, type of livestock enterprise, and availability of farm labor.

Hay

Dryland hay was a combination of alfalfa-brome, tame grass, or straight alfalfa established with a variety of small grains as a nurse crop. Hay was profitable for all management and soil combinations. Hay was limited to one-fifth of the total cropland acres. The amount of hay fed was influenced by size and type of livestock enterprise.

Wheat

Wheat could be produced either as durum or hard red spring wheat in rotation or on fallow. Durum was profitable under both management levels and for both soil textural groups. Durum usually was produced at its rotational limit of one-half the dryland acres when no livestock enterprise alternatives were included on the model farm. Durum acreage was influenced by the size and type of livestock enterprise. Durum was produced on fallow under normal management on low available water capacity soils. Hard red spring wheat was not included in any cropping pattern but could be substituted for durum with only a minor change in the profitability of the farm plan.

Sunflowers

Both oil and confectionery sunflowers are included as enterprise alternatives. Oil sunflowers were profitable for both management levels and soil textural groups when other specialty crops or livestock enterprises were not included. When livestock were produced, the dryland acres used to produce sunflowers occasionally were used to produce feed grain or forages—depending on the size and type of livestock enterprise. Sunflower production was restricted to once every 4 years because of rotational limitations.

Flax

Dryland flax was profitable under optimum management for both soil textural groups and under normal management on high available water capacity soils when livestock alternatives were not included. Flax was a competitive crop in most farm situations under optimum management on high available water capacity soils when livestock enterprises were included in the farm plan.

Corn Silage

Production of corn silage was directly related to size and type of livestock enterprise. Corn silage was used as a major feed source for many of the livestock enterprises. Corn silage was included in most farm plans for both management levels on high available water capacity soils when livestock enterprise alternatives were included.

Barley

Barley production was directly influenced by size and type of livestock enterprise and other sources of feed grains. Barley production was not included in the farm plan when livestock enterprises were not included. Irrigated corn grain production also influenced the production of barley since corn grain or barley could be utilized as a feed grain source.

Oats

Oats was included on the model farm with normal management on low available water capacity soils when the beef cow enterprise was included in the farm plan except when feed could be purchased. Size of the beef cow herd determined the acreage devoted to oats production.

Millet

Millet was included in most farm plans because of a shortage of early spring planting labor. Millet production increased as spring planting labor became more restrictive as additional land was rented or high labor using livestock enterprises were included in the farm plan.

Winter Rye

Labor shortage influenced winter rye production. Winter rye acreage increased as labor became restrictive because of the different labor periods utilized for planting and harvesting. A small acreage of winter rye was produced in most farm situations if millet was not produced.

Pasture

Dryland pasture was a combination of alfalfa-brome or tame grass established with a variety of small grains as a nurse crop. Dryland pasture was influenced by the size of the beef cow herd, dairy herd, and/or sheep flock. Dryland cropland was diverted to pasture when grazing requirements for livestock exceeded the carrying capacity of native pasture.

Native Pasture

Utilization of native pasture was directly related to the livestock enterprise and availability of farm labor. Native pasture was fully utilized only when the beef cow, dairy herd, and/or sheep flock were included in the farm plan. In most farm situations, native pasture was only partially utilized.

Livestock Enterprises

Livestock enterprises entering the profit maximizing farm plans were influenced by the availability of labor and the irrigated and dryland crop enterprises providing livestock feed.

Dairy

A dairy herd was the highest profit livestock enterprise under optimum management and second highest profit livestock enterprise under average management. A dairy herd also was competitive when all livestock enterprises were considered in the farm plan or feed was purchased; however, when livestock were allowed to be purchased, the dairy herd was replaced by a feeder cattle enterprise.

Feeder Pigs

The feeder pig enterprise involved feeding home-raised pigs or purchased feeder pigs to slaughter weight. The model farm plan for both management levels included the finishing of feeder pigs. The maximum size of the swine enterprises was based on resource limitations. The livestock purchase option increased the size of the feeder pig enterprise to its resource limit. The feeder pig enterprise also was competitive when all livestock enterprises were included as alternatives. A feeder pig enterprise was the highest profit livestock enterprise under normal management and second highest under optimum management.

Sow With Two Litters

One of the more profitable livestock enterprises was a sow farrowing two litters of pigs per year which were finished to slaughter weight. The pigs could either be sold as feeders or finished to slaughter weight. The model farm with either management level produced pigs as feeders if finishing to slaughter weight was not included as an alternative.

Feeder Cattle

This enterprise could utilize home-raised calves with the steers finished to a market weight of 1,050 pounds. Both steers and heifers were backgrounded with the heifers sold as yearlings and the steers finished to market weight. The size of the enterprise was directly influenced by availability of labor and feed. Finishing home-raised calves to slaughter weight was more profitable than backgrounding or selling the calves. Purchasing steer calves and finishing to slaughter weights were more profitable than feeding home-raised calves.

Beef Cow

The crop and livestock farm which included a beef cow enterprise provided approximately the same income as the all-crop farm. A small beef cow herd was competitive for farm resources under normal management on low available water capacity soils.

Sheep

Sheep could not compete for farm resources under normal management. Sheep were competitive under optimum management.

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