AN ECONOMIC COMPARISON OF THREE BEEF PRODUCTION MANAGEMENT SYSTEMS

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Irrigation has become increasingly popular with North Dakota farmers and ranchers who have an adequate water source and irrigable soils. With irrigation, producers reduce feed production risks associated with dryland farming in the Northern Great Plains. Consistent crop yields from year to year provide a stable feed source and allow cattlemen to develop a more consistent enterprise, reducing the need for "crisis management."

Corn silage, alfalfa and alfalfa-grass mixtures respond well to supplemental water, but their excessive bulk generally requires on-farm conversion to meat or milk. To evaluate the use of irrigated forages, a beef cow/calf enterprise was established at the Carrington Irrigation Branch Station in 1972.

Two management systems were evaluated by Dunn and Olson (1978) using straightbred Hereford cows. Results show that cow/calf gains were 607 pounds per acre of irrigated land using year around drylot management compared to 328 pounds for irrigated pasture in combination with winter drylot. Calf gains were 457 pounds per acre in drylot and 265 on irrigated pasture.

This study compares breakeven prices and returns of the cow/calf enterprise under drylot, irrigated pasture and range management conditions. Comparisons are made for drylot and irrigated pasture management at two North Dakota locations based on crop production data available at Carrington and Oakes. Breakeven prices and returns are calculated based on selling calves at weaning. Range production is also evaluated at two levels of production.

MATERIALS AND METHODS

Prior to any economic analysis, assumptions must be made to facilitate a valid and practical comparison. These assumptions relate to normal cultural practices for crop and livetock enterprises in North Dakota. The model irrigated farm unit used is 160 acres with a center pivot system. This is the standard size irrigation system with most operators using multiples of this unit. Water is pumped from a well 500 feet away, which is considered an average distance for irrigation systems in North Dakota. (Personal communication, Wayne Burbank, Extension Irrigation Specialist, NDSU.) System costs were established using data from 1970 to 1979.

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CROP PRODUCTION

Two levels of crop production are used to represent yields in the Carrington and Oakes agricultural areas. All yields and production costs are based on 10-year averages unless otherwise noted. Average corn silage and alfalfa yields are given in Table 1. The minimum field size used is 40 acres. Yields are calculated for 132 irrigated acres and 28 acres of dryland corners. Field operation costs were calculated using published custom rates minus 15 percent profit margin. Cropland used for corn silage would be fall plowed. Spring work includes herbicide/insecticide treatment, fertilizer application, tillage and planting.

Alfalfa stands were established using approximately 8 pounds of live seed per acre sown with oats as a nurse crop. Stands were considered to last five years. Oats were harvested as oatlage and one-year yields are given in Table 1. Alfalfa hay was windrowed/conditioned, square baled and hauled to storage with an automatic bale wagon.

Table 1.

IRRIGATED FORAGE YIELDS[1]

	LOCATION	
	Carrington	Oakes
Corn Silage Tons/Acre 30% DM	18.00	25.00
Alfalfa Hay Tons/Acre 85% DM	4.50	5.50
Oat Silage[2] Tons/Acre	11.50	14.50

[1]Average yields based on 10 year plot trials and field production data from Carrington and Oakes research sites. Yields are based on the 128 irrigated acres and 32 dryland acres of a 160 acre center pivot irrigation system.

[2]One year yields.

LIVESTOCK PRODUCTION

Livestock performance information for drylot and irrigated pasture used in the study is an average of pro-

duction data collected from 1973 to 1977 (Dunn and Olson, 1978). Approximately 90 cow/calf pairs were maintained on irrigatred pasture annually with 30 cow/calf pairs kept in drylot. Irrigated pasture cows were offered poloxalene (Bloat Guard) to retard bloat. All rations fed to drylot cows and to pasture cows were balanced according to National Research Council (NRC, 1976) recommendations. Table 2 gives annual feed requirements for the two management systems. Six 10-acre pastures were rotation grazed by cow/calf pairs assigned to the irrigated pasture treatment. The grazing treatment extended from late May to early September each year. Three pastures were seeded to a mixture of bromegrass, orchard grass and Garrison creeping foxtail. Three pastures were seeded to the same grass mixture in addition to pasture type alfalfa.

Livestock performance data for native rangleand was a 10-year average of North Daktoa Beef Cattle Improvement Association records. Two production levels were compared based on season-long stocking rates of 6.5 and 10.0 acres per cow/calf unit for high and low production native range areas, respectively. Production data for the three management systems is given in Table 3. The acres required per cow/calf unit for season-long grazing may vary considerably from the two values using depending on soil type, rainfall, topography and range conditions. Establishing a cost for grazing is difficult. If producers own their own pastures, opportunity costs must be considered on the investment. Leasing range is often less expensive but generally more uncertain in both availability and cost. Leases are offered on a per acre or per animal unit month (one cow/calf pair grazing for one month) basis. Opportunity cost of owning range averaged $17.20 per acre per year for the 10-year period from 1970-1980.

The number of cow/calf pairs used in the analysis is based on the feed production from the model farm's irrigated cropland. Oats and straw used in formulating rations were priced at 10-year average market prices of $.96 per bushel and $25/ton, respectively. Cost of hauling manure is assumed to equal the fertilizer value. Labor rate of $2.27/hour was a 10-year average calculated from North Dakota price statistics.

The natural breeding system used required one bull for 25 cows with a four-year useful life of bulls. Percent calf crop given in Table 3 represents proportion of calves weaned to cows exposed. Calving season extended from mid March to early May. Open and cull cows were sold after weaning and pregnancy testing in late Octber. All livestock prices used are calculated from North Dakota Livestock Price Statistics 1970-1980.

DATA ANALYSIS

Production data were analyzed using the AGNET COWCOST program which examines the costs and returns for a beef cow/calf enterprise. Input for cow/calf production data is given in Tables 3 and 4. Land is considered a fixed asset. Death losses are assumed to occur at the end of the production cycle. Interest is charg-

Table 2.

ANNUAL FEED REQUIREMENTS[1] PER COW/CALF UNIT UNDER TWO IRRIGATED FORAGE MANAGEMENT SYSTEMS

	MANAGEMENT SYSTEM					
	DRYLOT			IRRIGATED PASTURE		
Feed	Cow	Creep Feed[2]	Total	Cow	Creep Feed[2]	Total
Corn Silage (Ton)	5.00		5.00	3.02		3.02
Alfalfa Hay (Ton)	2.05	.10	2.15	1.36	.06	1.42
Straw (Ton)	.65		.65	.65		.65
Oats (Bu.)		5.25	5.25		2.96	2.96
Salt/Mineral (Lb.)	25.00		25.00			
Poloxalene (Lb.)				48.80		48.80
AUM[3]				4.55		4.55

[1]Based on feeds used and National REsearch Council recommendations.
[2]Creep feed offered consisted of 50% chopped falfalfa hay and 50% whole oats by weight.
[3]Animal unit month of grazing based on 1 cow/calf unit grazing for 31 days equals 1.3 AUM.

Table 3.

PRODUCTION DATA FOR THREE COW/CALF MANAGEMENT SYSTEMS

	DRYLOT[1]	IRRIGATED PASTURE[1]	RANGE[2]
Conception Rate (%)	90.6	85.2	---
Calf Crop Weaned (%)	88	83	80
Weaning Weight	459	467	430

[1]Data compiled from straightbred Hereford cattle 1972-1977 at Carrington Irrigation Station.
[2]Data based on North Daktoa Beef Cattle Improvement Association records 1971-1980.

Table 4.

INPUT DATA FOR COWCOST PROGRAM[1]

	DRYLOT	IRRIGATED PASTURES	RANGE
Value of cows ($/hd)	378	378	378
Value of replacement heifers ($/hd)	398	398	398
Replacement rate (%)	16	16	16
Annual interest rate (%)	9	9	9
Average investment per bull ($/hd)	1100	1100	1100
Bull salvage value ($/hd)	653	653	653
Labor costs ($/cow@2.27/hr.)	26.67	28.15	15.89
Herd health (including fly control) ($/hd)	12.00	11.50	10.00
Fuel costs ($/hd)	9.00	7.00	6.00
Marketing & transportation costs ($/hd)	8.00	8.00	8.00
Miscellaneous costs ($/hd)[2]	5.00	5.00	5.00
Investment in buildings & equipment ($)[3]	30,000.00	30,000,00	25,000,00
Useful life of buildings & equip. (yrs.)	20	25	30
Interest rate on buildings & equip. (%)	9	9	9
Taxes & insurance ($/hd)	10.00	10.00	10.00
Annual death rate (%)	1.5	2.0	2.0
Weight of cull cows (lb.)	1100	1100	1100
Market price for cull cows ($/cwt.)	27.49	27.49	27.49
Price for calves ($/cwt.)	50.97	50.97	50.97

[1]Ten year average prices from North Dakota Price Statistics.
[2]Eartags, record keeping and other unidentifiable costs.
[3]Represents capital ivnestment in buildings and equipment necessary for a cow/calf operation.

Table 5.

ACREAGE REQUIREMENTS FOR IRRIGATED FORAGE PER COW/CALF UNIT[1]

	Carrington		Oakes	
Crop	Drylot	Irrigated Pasture	Drylot	Irrigated Pasture
Corn Silage	.28	.17	.20	.12
Alfalfa Hay	.48	.32	.39	.26
Irrigated Pasture	---	.64	---	.53
Total Acres	.76	1.13	.59	.91

[1]Based on rations used at Carrington Irrigation Station.

Table 6.

CROPPING PLAN FOR DRYLOT AND IRRIGATED PSTURE MANAGEMENT SYSTEMS

	Drylot	Irrigated Pasture
Corn Silage (acres)	80	40
Alfalfa Hay (acres)	80	40
Irrigated Pasture (acres)	--	80

ed on the breeding stock, capital investment, feed and operating costs. Breakeven prices for variable and total production costs are reported.

RESULTS AND DISCUSSION

More cows can be maintained on the same land base under drylot management than irrigated pasture or dryland range. The "carrying capacity" from one 160-acre center pivot irrigation system (130 acres irrigated) for drylot at Carrington is 200 cow/calf pairs. The irrigated pasture system will support only 135 cow/calf pairs. Proportions are the same for Oakes with 260 cow/calf pairs supported in drylot and 170 pairs supported on the irrigated pasture system. Table 5 gives the acreage requirements per cow for the two management systems at Carrington and Oakes. Actual carrying capacity may vary from these figures due to soil type, weather, fertility levels, crop varieties, cow size, cow efficiency and herd management.

"Carrying capacity" is influenced by two factors. Grazing cattle harvest approximately 62 percent of standing alfalfa and alfalfa-grass forage. Drylot cows receive mechanically harvested forage with approximately 85 percent availability at the feed bunk (Dunn and Olson, 1978). The reduced utilization by grazing cattle required additional acres of alfalfa in the cropping plan (See Table 6). Corn silage produces more total digestible nutrients (TDN) per acre than alfalfa hay. Using the irrigated pasture requires more acres planted to alfalfa and fewer acres in corn silage so total energy production is reduced. Using average yields at Carrington of 18 ton/acre, corn silage harvested at 70 percent moisture results in 3.78 tons of TDN produced per acre. Alfalfa hay produces 2.18 tons of TDN per acre with average yields of 4.5 tons/acre. In the cropping plan given in Table 6, 80 acres are dedicated to corn silage using drylot management. With irrigated pasture management, only 40 acres of corn silage can be grown due to the increased acres of alfalfa-grasss pastures required for grazing.

Lower feed costs at Oakes reflect increased production efficiency from a longer growing season. Cost of production is approximately $3 per ton less for both corn silage and alfalfa hay at Oakes (See Table 7). Calculated grazing costs are higher per acre at Oakes due to higher land costs. Carrying capacity at Oakes was not measured directly but extrapolated from irrigated forage yield data at Oakes and grazing efficiency data collected at Carrington.

Increased labor costs for daily feeding of drylot cows is largely offset by time spent managing cows on irrigated pasture. Drylot cows are closely observed in a small area at daily feeding. Cows on irrigated pasture require frequent, more time-consuming checks. Pasture management also requires fence repair, moving cattle, poloxalene block distribution and increased time to treat sick animals.

Annual feed costs (Table 8) were lowest for drylot cows with range cows having the highest feed costs. Other variable costs and fixed costs were lowest for range production. Total costs per cow adjusted for value of cull cows were lowest for drylot with high production range very close to Carrington drylot.

Breakeven prices are given in Table 9 to cover variable costs and all cost. Drylot management produced the lowest breakeven prices with range production resulting in highest breakeven costs.

Major criteria contributing to the advantages of drylot cows are higher conception rate (Table 3), higher calf crop weaned (Table 3), weaning weights heavier than range but less than irrigated pasture (Table 3), and feed costs and other costs lowest among the three management systems.

Considering today's market, the economic analysis presented in this report may give the reader a pessimistic picture of the profitability of a cow/calf enterprise. However, several management practices are available to improve efficiency of production. More crop residue could be utilized in wintering rations for mature beef cows. Application of anhydrous ammonia to corn silage and straw economically increases feed value. Small grain and hayfield residue can be grazed or mechanically harvested. Chopping and mixing crop residue with corn silage reduces waste and improves palatability. Implanting steer calves pre and post weaning increases rate of gain. Adding monensin sodium (Rumensin) to the ra-

Table 7.
FEED PRICES BASED ON YIELDS AND COSTS OF PRODUCTION AT CARRINGTON & OAKES[1]

	Carrington	Oakes
Corn Silage ($/ton)	13.46	10.43
Alfalfa Hay ($/ton)	34.66	31.60
Grazing ($/acre)	128.85	146.68

[1]Costs are based on ten year averages.

Table 8.
COSTS OF THREE COW/CALF MANAGEMENT SYSTEMS AT TWO PRODUCTION LEVELS

	DRYLOT		IRRIGATED PASTURE		RANGE	
	Carrington	Oakes	Carrington	Oakes	High Prod.[1]	Low Prod.[2]
Number head	200[3]	260[3]	135[3]	170[3]	200[4]	200[5]
Annual Feed Costs/Hd	165.48	143.76	200.78	182.57	229.33	289.53
Other Variable Costss/Hd	74.11	72.40	77.58	75.19	60.07	62.78
Fixed Costs/Hd	66.11	63.62	72.36	68.02	61.91	61.91
Total Costss/Hd[3]	305.70	279.78	350.72	325.78	308.98	371.89

[1]High production native range with 6.5 acres per cow/calf unit for sseason long grazing.
[2]Low production native range with 10.0 acres per cow/calf unit for season long grazing.
[3]Number of cows supported by one 160 acre center pivot irrigation system.
[4]Herd size used for range production comparison.
[5]Adjusted for value of cull cows sold.

Table 9.
BREAKEVEN PRICES AND RETURNS FOR COW CALF ENTERPRISE WHEN CALVES ARE SOLD AT WEANING

	DRYLOT		IRRIGATED PASTURE		RANGE[1]	
	Carrington	Oakes	Carrington	Oakes	High Prod.[1]	Low Prod.[2]
Breakeven Price for Calves To Cover:						
Variable Costs	59.23	52.14	75.44	68.85	89.78	112.64
All Costs	79.24	71.39	98.56	90.59	112.27	135.13
Gross Income/Cow	212.29	212.29	201.81	201.81	182.60	182.60
Gross Income/Acre	226.88	268.02	124.87	156.40	23.56	15.22
Calf Gain (Lb/Acre)	456	548	265	318	55	36

[1]Data taken from 10 year average of cow/calf budgets and North Dakota Beef Cattle Improvement Association records.
[2]High production native range 6.5 acres per cow for season long grazing.
[3]Low production native range 10 acres per cow for sseason long grazing.

tion also increases rate of gain and feed efficiency (Carrington Irrigation Field Day Proceedings, 1977 and 1980). Crossbreeding increases efficiency of production with up to 23 percent more pounds of calf weaned per cow exposed. Crossbred cows mature earlier, produce more milk, are more fertile and are better mothers than straightbred cows (Cundiff, 1970). Production testing in a commercial herd is strongly encouraged. Researchers in Washington report a $7 to $10 advantage per cow in production tested herds. Good bulls from production tested herds can also contribute to herd improvement. Artificial insemination will increase the speed of genetic progress in your herd but it is labor intensive at a critical time of the year.

Range management has been and continues to be an important research topic in North Dakota and other livestock states. Drylot cow/calf production will not replace range beef production because the grazing animal is the only method to harvest non-tillable grasslands. However, this study concludes that a drylot cow/calf enterprise has the potential to be an economical and efficient beef production system. Forages produced under irrigation are the consistant feed base needed for a stable cow/calf enterprise. Drylot could also be used with dryland farming, but the feed supply would be less predictable. Cattlemen interested in improving efficiency or expanding their herd on a limited land base should critically evaluate a drylot program as a method of accomplishing their goals.

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distribution of published research results by county extension offices.

This station's primary responsibility is in the crop production area. The staff work closely with NDSU plant breeders, pathologists, soil scientists, entomologists, horticulturists, cereal technologists, and engineers to name a few. Cooperation is present in both the public and private sector. In addition to these areas staff also research local and area needs. Examples include research on controlling false chamomile, a troublesome weed in Renville, Bottineau and Ward Counties. This weed is difficult to kill and is spreading rapidly from field to field. Presently the herbicide chlorsulfuron (Glean) works very well in controlling false chamomile in small grains.

Another topic of great interest is no-till farming methods which are becoming so popular in the corn-producing areas of the country. This method is being evaluated by branch stations and NDSU personnnel. The results are so encouraging that some farmers are giving it a try. Along this vein, new research has been initiated to develop procedures which will maximize yields using the most productive farming practices.

Considerable research is conducted off station. Each year small grain variety trials are planted on sites in two counties. Trials are run at those sites for a three-year period in each county, then the site is rotated to a new county. Over the years trials have been conducted in eight counties, in addition to the on-station sites and an irrigated/dryland site at Karlsruhe (McHenry County). Station staff also plant two field-scale oil sunflower trials each year and these are placed at various locations throughout the 12-county area. These sites are all cooperative efforts between the station, the county's extension agent and crop improvement association,and the farmer providing the site.

The irrigation project is a cooperative effort between the Garrison Conservancy Irrigation District, the Karlsruhe Irrigation District, the Bureau of Reclamation, and this station. Research includes row crops, small grains, and forages. The majority of plots are planned for production results, with others evaluating farming methods, herbicides, diseases, and cropping rotations.

Through the use of services and research data provided by branch experiment stations like ours, farmers have been able to greatly increase the quality and quantity of their output. This in turn has added greatly to our state's economic base. In the long run, our branch stations have many times over paid back their cost to the North Daktoa taxpayer.