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# IMPROVING BEEF PRODUCTIVITY AND MANAGEMENT

THE POTENTIAL IMPACT ON THE ECONOMY  
OF NORTHERN MINNESOTA

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## INTRODUCTION

The beef cow-calf industry is an important agricultural enterprise in northern Minnesota and makes a substantial contribution to the regional economy. Alternative agricultural enterprises are limited in much of this area. Cash crop production is limited in northeastern Minnesota because of the cool, short growing season. Dairy, as an enterprise, has limitations because of the distance to markets for fluid milk. Therefore, the 2 million acres of grasslands available for pasture use in the 38 northern Minnesota counties (figure 1 and table 1) can be best utilized with the beef cow enterprise. The cow-calf herd can use both the non-tillable pasture as well as provide an outlet for the hay crops produced in the area. This enterprise provides opportunities for either part-time or full-time farming operations.

In terms of economic significance the beef cow enterprise provides a large portion of farm income for the Upper Great Lakes Region (UGL). In 1978, the marketing of beef cattle and calves provided approximately \$106 million dollars in cash income to producers in the UGL region. This income level could be increased to higher levels by overcoming constraints now faced by the beef cow-calf producer through improved crop and livestock management practices.

In a recent survey of the Minnesota beef cow-calf industry,(1) producers listed land and labor as the most limiting constraints for expansion. Over half listed land as the most critical factor, while one-third listed labor as a major constraint, followed by equipment and credit.

Table 1. Pasture Land Use For The 38 Upper Great Lake Counties

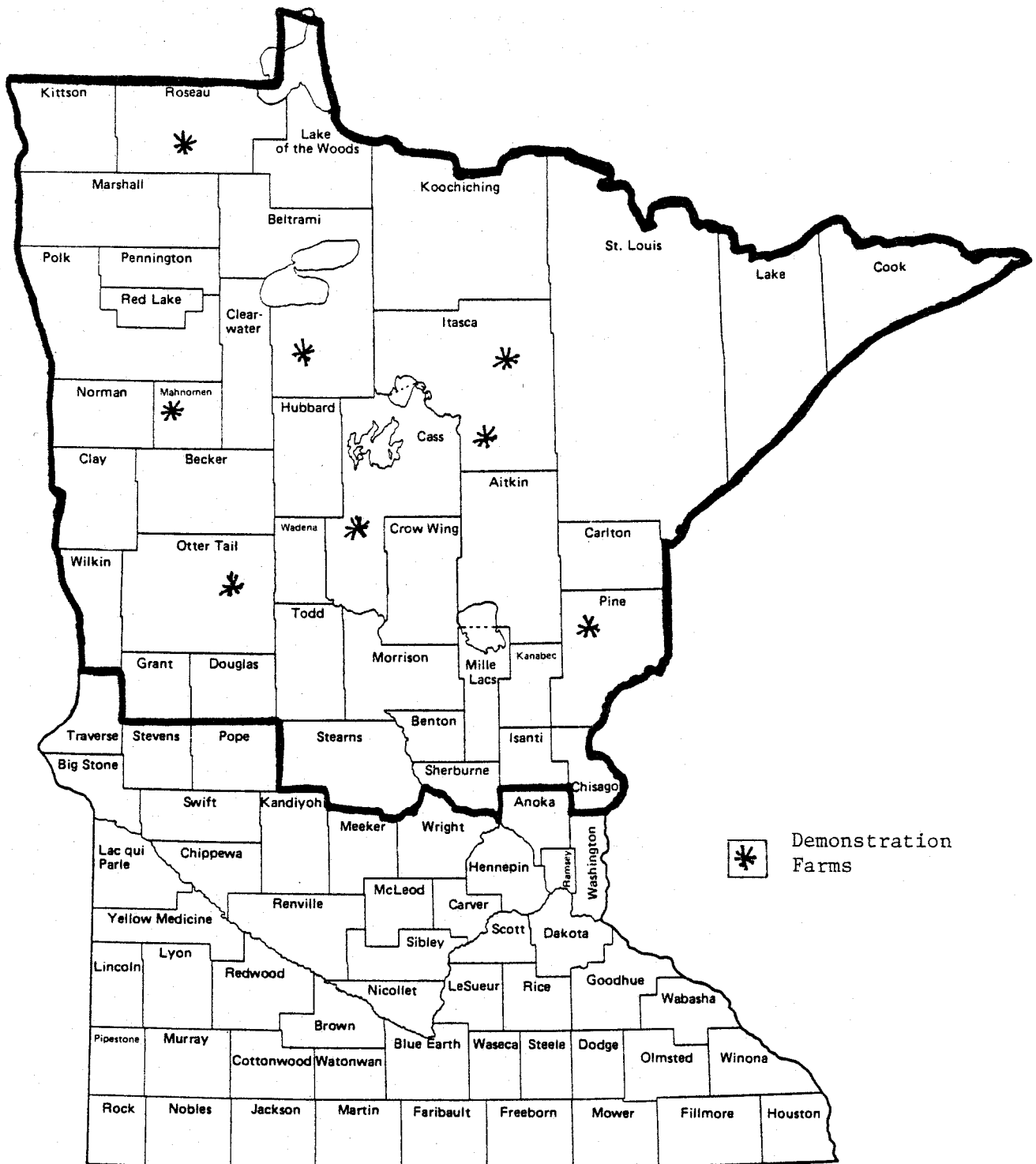
	Cropland Used For Pasture <sup>a</sup>	Woodland Pasture	Woodland Not Pastured	Improved Pasture <sup>b</sup>	Unimproved Pasture
Total acres, 1974	847,591	752,021	671,540	179,455	549,692
Adjusted Acres For Beef Production <sup>c</sup>	692,832	606,697	703,102	101,769	538,169

<sup>a</sup> Cropland used for pasture is rotational pasture and grazing land that could have been used for crops without additional improvements.

<sup>b</sup> Improved pasture is land on which fertilizer, herbicides and lime have been applied or the land improved by irrigation or drainage.

<sup>c</sup> Adjusted for trends in land use along with pasture requirements for horses, sheep and dairy cows.

Figure 1. Upper Great Lake Region's 38 Counties



Labor and land constraints can be partly overcome through higher productivity of existing resources by adopting improved forage and livestock practices. For example, it was demonstrated in a recent Extension demonstration project on 8 northern Minnesota beef farms and ranches (figure 1) that the carrying capacity per acre can be doubled as a result of improved forage management. In addition, improved livestock management practices will result in a higher percentage calf crop and increased weaning weights. Such improvements could enable expansion of beef production on currently owned land by producing both more and heavier cattle, resulting in greater income earned per acre and per animal.

These improved practices have been adopted beyond the demonstration farms as a result of the educational work of the Agricultural Extension Service and other state and federal agencies to disseminate these techniques throughout the UGL region. A recent survey of professional agriculturalists showed widespread support and interest in this educational program to enhance the productivity of existing resources in northern Minnesota. (2) As this educational process continues and adaptation of these proven practices occurs throughout the UGL region, the cash receipts of all beef producers will be increased. As cash receipts increase, additional economic activity will be generated because as the increased production occurs producers expand purchases--giving farm input industries increased sales. This, of course, means that other sectors of the regional economy will also have increased earnings. In other words, improved beef production as a result of the UGL project will be stimulating to both the agricultural and the non-agricultural sectors of the region's economy.

#### OBJECTIVE OF STUDY

It is the purpose of this paper to estimate the potential economic benefits resulting from improved management practices in beef cow-calf operations in the 38 counties of the Upper Great Lake Region of Minnesota (figure 1). The paper will first explain these improved management practices and the increased farm earnings that result from their implementation. Then increased economic activity for the state of Minnesota will be estimated by using an input-output simulation model that has been developed for Minnesota which requires, as input, the aggregate of the increased farm earnings expected to be generated as a result of the UGL project.

#### IMPROVED MANAGEMENT PRACTICES

This section discusses the major approaches that were used to improve pasture and hay production, livestock management, and total farm/ranch management. These practices were successfully demonstrated at 7 locations over a 5 year period on 8 farms and ranches in Beltrami, Carlton, Cass, Itasca, Mahnomen, Otter Tail and Roseau counties (figure 1).

### Pasture And Forage Management

The objective of the pasture system demonstration was to increase pasture quality as well as production throughout the grazing season, and to expand pasture utilization into the non-grazing season by harvesting hay from high yielding pastures.

The following improved pasture management practices were demonstrated on the cooperating farms:

- The application of nitrogen fertilizer to increase cool-season grass pasture yields for higher utilization in both spring and fall seasons.
- The increased use of rotational grazing through improvement in fencing pasture management practices.
- The use of improved species of cool-season grasses, and/or the use of legumes or combinations of grass-legume mixtures to improve yields throughout the grazing season.
- The use of herbicides for weed control when needed to improve forage production.

The four pasture systems used for comparison included the original unimproved pasture (system A) and the following three improved systems:

- System B, a combination of legume birdsfoot trefoil along with fertilized grass.
- System C, a combination of alfalfa with fertilized grass.
- System D, fertilized Kentucky Bluegrass in rotational pasture.

Table 2 lists the average production results for the 4 pasture systems used on the 8 demonstration farms over the study period. These improved production levels increased stocking rates 2.5 times over the original unimproved pasture. In addition, cows came off pasture in better condition as evidenced by the higher daily gain shown in table 3. The extra cow gain while on pasture provides the producer with a heavier, healthier herd that will not need as high a level of nutritional maintenance during the winter.

Table 2. Average Production Of Pasture Systems On The UGL Demonstration Farms 1975-79.

<u>Pasture System</u>	<u>Cow Day Per Acre</u>	<u>Calf Day Per Acre</u>	<u>Cow Gain Per Acre</u>	<u>Calf Gain Per Acre</u>	<u>Acres Required For 144 Day Grazing Season</u>
System A - Unimproved	31	25	25	46	4.65 acres
System B - Trefoil and Fertilized Grass	96	101	88	149	1.50 acres
System C - Alfalfa and Fertilized Grass	138 <sup>a</sup>	96	147 <sup>b</sup>	138	1.60 acres
System D - Fertilized Blue Grass	80	75	66	119	1.80 acres
Average Improved System	104	90.6	100.3	135	1.60 acres

<sup>a</sup> Includes 47 cow days per acre from harvested hay

<sup>b</sup> Includes 72 pounds of gain from harvested hay

Table 3. Average Daily Gains For Cow And Calves (Pounds Per Day)

	<u>System A</u>	<u>System B</u>	<u>System C</u>	<u>System D</u>
Cow	.80	1.05	1.05	.94
Calves	1.84	1.70	1.84	1.80

In summary, the improved forage management practices demonstrated to area producers that (1) pasture carrying capacities could be increased, (2) more rapid calf gains resulted in higher calf weaning weights and (3) higher cow gains resulted in reduced cow wintering costs. (A more detailed description and economic evaluation of these alternative grazing systems is available as a reprint of two articles in the 1981 International Forage and Grasslands Proceedings. (3,4)

### Livestock Management

A breeding program to help obtain faster gaining, higher quality calves is one improved livestock management practice. An improved program might include the use of performance testing, better bull selection, and crossbreeding.

Other improved livestock management techniques demonstrated were:

- The use of growth stimulants on calves and yearlings
- Insect and parasite control
- Calf warming boxes and shelters
- Early castrating and dehorning
- Nutritional improvements such as grain feeding calves during the winter and reducing bloat hazard while on pasture.

These improvements in livestock management in combination with the improved forage management were estimated to give rise to at least a 5 percentage point gain in calf crop weaned, along with a 50 pound increase in average weaning weights on the UGL demonstration farms.

The quantitative benefits of each of the above practices were not measured individually. However, considerable evidence exists in the literature and from the demonstration farms to justify weaning weight increases of 50 pounds and a 5 percentage point increase in the calf crop. A significant proportion of the 50 pound weight gain can be attributed to growth promoting implants. Demonstration results showed a 6 to 8 percent increase in weaning weights (25 - 35 pounds per calf) with other studies recording similar or better results. (5,6,7,8) Fly control also increased weaning weights by 3 to 4 percent on the demonstration farms and in other studies. (9,10) Genetic improvement through better selection and performance testing will increase performance indicators such as rate of gain, increased calf crop, higher weaning weights and feeder quality. (11,12)

Improved forage quality also helps to increase calf crop size and weaning weights. A range reseeding study attributed a 6 percent increase in calf crop weaned to improved pasture systems. (13)

In summary, improved livestock management alone can significantly influence both the quality and quantity of feeder cattle production on individual farms and ranches; and, of course, for the entire UGL region and the state of Minnesota.



### Other Management Practices

Other management tools and procedures can further help individual producers make better production, financial and marketing decisions. Among the farm management techniques used with the demonstration farm operators were annual beef cow budgets and calf feeding budgets which projected costs and returns for the year ahead for calf overwintering programs as well as for the cow-calf enterprise. Alternative marketing strategies such as selling the calf in the fall versus selling the yearling in the spring or in the following fall could then be evaluated as to which offered the possibility of higher net returns.

High cost items could be spotted through enterprise analysis and attempts made to control them. For example, increasing interest rates or hay prices greatly increase the cost of over-wintering a cow--making it very costly to keep a non-pregnant cow for a year without getting any production out of her.

The combination of better cost control and improved marketing decisions helps producers obtain higher net incomes with existing land and labor resources. For example, the choice of a cow-yearling program over a cow-calf program can add over \$1,000 of net income in an average year to a farm that normally supports a 65 - 70 cow herd when the feeders are sold as calves. An additional \$2,000 or more can be added to the operation in the years following the "bust" years that have occurred just prior to the middle of each decade in the past 4 cattle cycles. (14)

## ECONOMIC IMPLICATIONS

### Individual Producer Benefits

The improved management practices and strategies discussed in previous sections can translate into substantial gains in net income to producers willing to use them. Table 4 summarizes the potential added net income to a 100 cow beef operation which switches from the "typical" management practices followed on northern Minnesota beef farms to a system adopting the demonstrated improved techniques. With the combination of better livestock management, forage management, and other management improvements these estimates indicate that the "typical" producer could increase net income by about \$80 per cow. However, such an increase would entail more time devoted to managing the cow herd--a cost not estimated in table 4. Historically, most small herd owners have not been willing to invest either the time or the added operating costs--perhaps, in part, because they were not aware of the potential gain.

### Regional Economic Benefits

The economic implications for the state of Minnesota would be the sum of the increased earnings of the approximately 12,000 beef producers

Table 4. Additional Net Income To A 100 Cow Beef Operation Utilizing Improved Management Techniques Instead Of Typical Ones.

I. Improved livestock management benefits:  
(combined with better pasture quality)

- Increased calf crop - 5%	5 calves x 420 lbs. = 2,100 lbs.
- Improved weight gain from growth promoting implants	25 lbs. x 80 calves* = 2,000 lbs.
- Increased weaning weight from improved breeding management	13 lbs. x 80 calves* = 1,040 lbs.
- Increased weight due to insect and parasite control	16 lbs. x 80 calves* = <u>1,280 lbs.</u>
Added production weight of beef calves sold	
	6,420 lbs.
Market value	<u>.75/lb.</u>
Gross value	\$4,815.00
Less cost (\$18/calf)	<u>1,530.00</u>
Net added value	\$3,285.00

II. Improved forage management benefits:

(assume currently required 5 acres per cow of unimproved pasture)

- Acres required with improved stocking rate of 2.5 acres per cow	250 acres
- Acres freed for hay production with improved stocking ratio	250 acres
- Gross value of added hay production	\$35 x 2.5 T/A x 250 A = \$21,875.00
- Variable costs of production	\$30.50 x 2.5 T/A x 250A = <u>19,062.50</u>
Added net income	\$ 2,812

III. Other management benefits:

- Improved marketing (\$10 per head)	\$800
- Enterprise shifting from cow-calf to cow-yearling	<u>\$1,500</u>
Total net added income potential with full adoption of improved management practices	\$8,397

\* Does not count the extra weight on the 15 heifer calves kept for herd replacements.

in the 38 county UGL region, plus the increased output from other related economic activity generated by the increased agricultural production.

Through the development and improvement of unimproved pasture along with existing improved pasture (table 1), the producers in this region have two possible scenarios for economic growth. The alternatives are (1) to use the "saved" acreage to expand beef herds with only minor increases in crop production or (2) to expand crop production on the released acreage combined with only a minor increase in the "improved" beef cow herd.

Either development scenario has the potential to increase total cash receipts to farmers by over \$100 million per year. The increase in cash receipts by farmers will affect the expenditures of local supply industries and the subsequent level of sales from interrelated industries. The potential increases in total economic activity under each of the two scenarios of development can be estimated using Simlab methodology. (15)

Simlab is a computer based regional socioeconomic forecasting model used to analyze the direct, indirect and induced socioeconomic effects of an event, such as the development of a new crop or the expansion of livestock production. The Simlab model is an input-output model based on the U.S. Department of Commerce's input-output tables showing historical linkages among interacting industries. The model will forecast the economic impact resulting from purchases made by producers who have increased incomes--such as the beef producer in the study. As other businesses become affected by furnishing inputs to beef producers, the increased sales volume of their suppliers, in turn, induces spending at other wholesale and retail establishments. These changes in economic activity are all measured with the Simlab model which assumes that future changes will follow similar patterns as past changes.

The two development scenarios used are (1) beef cow expansion and (2) crop expansion. Under either alternative, it is assumed that there is a gradual adoption over a 10 year period of the improved practices demonstrated on the UGL farms until most of the available land is under improved management practices. The results reported below are the potential increases in economic activity in Minnesota if opinion leaders continue to educate and encourage beef producers in northern Minnesota to adapt the management practices demonstrated on the 8 UGL cooperating farms in the late 1970's.

Under the beef cow expansion scenario, improvements in forage practices could eventually support a maximum beef cow herd of 650,000 on 1.3 million available acres. The acreage that is projected to be upgraded, using UGL demonstrated forage techniques, is the improved and unimproved pastureland and cropland used for pasture in 1974 as shown in table 1. (This excludes woodland used for pasture (overgrown pasture with shrubs and low density trees) which could also be cleared for future expansion

of the beef cow herd, as was demonstrated on the demonstration (Ole Moe) farm near Bemidji, Minnesota.)

The expansion of the beef cow herd in the Simlab model is under the assumption that with improved pastures for beef cows the stocking rate will be two acres per cow-calf unit. (An attainable stocking rate requiring 20 percent fewer pasture acres than used in table 4--some of which can be obtained from "woodlands used for pasture".) Herd expansion is allowed at the rate of 10 percent per year, while culling occurs at 12 percent until land constraints limit expansion.

This results in a steady annual increase in cash receipts for the region as more and heavier feeder animals are marketed each year. The upper limit of additional cash receipts to beef producers generated as a result of the diffusion of the improved management practices demonstrated on the UGL farms approaches \$128 million after 12 years (table 5).

Table 5. Added Potential Cash Receipts In 1980 Dollars To Buy Producers Over Time From Expansion Of Livestock Production, In \$1,000 Dollars

1980	\$ 2,048
1985	43,607
1990	110,206
1995	127,724
2000	127,724

In the crop expansion scenario there would be a significant expansion of cash crop production along with a moderate expansion of the beef cow herd. As in the first alternative, increased acreage becomes available as a result of the higher stocking rates possible under improved forage management. This enables the northern Minnesota cow herd to be pastured on the acreages categorized in 1974 as "improved" and "unimproved" pastures, thus allowing all "cropland used for pasture" to be used for the production of cash crops instead of for pasture.

This converted acreage for crop production is assumed to occur over a 4 year period with the acres used in the production of crops in the same proportion as crops have been grown in the UGL area of northern Minnesota in recent years and with the same yields. These assumptions give rise to an increase of \$88.2 million in cash receipts to farmers from the additional crop production.

In addition to the \$88.2 million in expanded crop production, the livestock sector would increase cash receipts to producers by \$25.2 million. This livestock contribution is the result of the adoption of improved management practices on the existing beef cow herd plus a

gradual expansion of the herd by 30 to 40 percent over the levels of the last 10 years. This results in a total increase of almost \$115 million to the region's agricultural economy from the crop expansion alternative in contrast to the \$127.7 million increase from the livestock expansion alternative shown in table 5.

The Simlab model is used to measure the stimulatory effects of the above projected increased farm sales upon the total economy by comparing the results of the projected improved farm sector performance against a baseline projection made without such an improvement. The baseline comparison output projects future growth in the absence of any new events (such as improved beef management) based upon past trends of economic growth for the inter-linking industries. The main impact estimates are in terms of industry gross output, intermediate sales and purchases, employment, earnings, and levels of trade in the 55 economic sectors of the model. The Simlab model uses 1970 dollars, so the above estimates of increased cash receipts are deflated using "prices received by farmers" index for crops (1979 = .362) and livestock (1979 = .4945) before using in the model.

When all the acreage was used for expanding beef production (scenario I), the projected potential increase in gross output for the entire region was \$408 million in 1970 dollars after 20 years of development. Nine sectors that showed relatively large changes (table 6) accounted for 55 percent of the total increase in output. These sectors, therefore, have the strongest linkages with the increase in cattle production. It is interesting to note that the sector showing the largest change (excluding the livestock sector) is the retail sector. From the model, an estimate of multiple effects of the increased production shows that after 20 years each dollar increase agricultural sales results in an additional 2.38 dollars in other output increase--a multiple of about 3.4.

Table 7 shows the potential increases in employment and earnings expected as a result of expanded output of beef cattle. The agricultural sector shows increases in earnings of \$12.7 million, while the state would have increased employment of 9,000 workers, creating a total increase of almost \$80 million in earnings if the diffusion of the improved management practices demonstrated in the UGL project can be continued through the decade of the eighties.

The data in table 8 shows projected increases in intermediate purchases--the amount of purchases made directly by the agricultural sector from all supplying sectors--during the next 20 years.

Similar results were obtained for the second scenario--expansion of crop production and a moderate increase in cattle production. The total increases in the gross added output would be smaller under this adjusted scenario. This is based upon the varying linkages of industry sectors and reflects the historical fact that when land is used to produce feed for livestock production there is more economic activity in the region than if it is used for cash crop production.

Table 6. Projected Potential Increases in Gross Output From Baseline For Different Industries Due To Increased Cattle Production - (\$1,000 Units in 1970 Dollars)

Industry	1985	1990	1995	2000
1. Livestock	24,799	66,638	87,053	90,587
2. Other Agriculture	8,273	21,577	27,706	30,503
3. Food Production	1,404	5,444	11,216	13,827
4. Meat Production	317	1,681	4,192	5,391
5. Chemical & Petroleum	1,131	3,216	5,425	6,497
6. Transportation	1,089	4,119	2,958	4,551
7. Finance	937	6,127	6,129	11,399
8. Wholesale	4,080	9,945	17,239	19,489
9. Retail	3,986	15,654	35,207	41,881
Total (9 sectors)	46,016	134,401	197,125	224,125
Total of Region	83,289	226,297	356,297	408,792

Table 7. Projected Potential Increase In Earnings And Employment Due To Cattle Expansion - (\$1,000 Units in 1970 Dollars)

Year	Agricultural Sector		Statewide	
	Employment	Earnings	Employment	Earnings
1985	746	3,927	2,117	17,933
1990	1,613	10,660	5,520	46,954
1995	1,707	11,272	8,501	72,864
2000	1,876	12,755	9,145	79,735

Table 8. Projected Increase In Intermediate Purchases Of The Agricultural Sector Under the Livestock Expansion Scenario - (\$1000 Units in 1970 Dollars)

	Year			
	1985	1990	1995	2000
Increase over Baseline	\$19,773	\$52,894	\$68,924	\$72,372

Table 9. Projected Increases In Gross Output For Different Industries In 1970 Dollars Due To Major Crop Production Increases Made Possible by Improved Crop and Livestock Management Practices (\$1,000 Units in 1970 dollars)

Industry	1985	1990	1995	2000
1. Livestock	21,638	22,543	24,453	23,141
2. Other Agriculture	44,068	37,910	43,187	40,766
3. Food Production	1,876	5,738	8,117	10,689
4. Meat Production	580	2,492	3,545	4,821
5. Chemicals & Petroleum	3,508	3,848	5,364	6,068
6. Transportation	1,973	2,958	4,551	5,478
7. Finance	1,799	7,701	7,701	11,799
8. Wholesale	9,329	7,453	13,994	16,813
9. Retail	8,341	19,617	28,418	38,163
Total (9 sectors)	93,113	110,263	139,332	157,740
Total of Region	173,722	178,695	275,200	309,775

This is because of the larger amount of inputs required to produce, market and process livestock than required in cash crop production and marketing. Somewhat smaller increases of both employment and earnings are shown in table 10 for the crop expansion as compared to the livestock expansion scenario increases shown in table 7.

Table 10. Projected Increases In Employment And Earnings Due To Major Crop And Minor Livestock Expansion (\$1,000 units in 1970 Dollars)

	Agricultural Sector		Statewide	
	Employment	Earnings	Employment	Earnings
1985	542	6,430	4,900	40,812
1990	1,113	8,950	5,731	41,106
1995	1,410	10,420	7,182	62,279
2000	1,655	12,732	7,775	67,697

Table 11 shows changes in intermediate purchases. Comparison with the data in table 8 shows that the livestock expansion scenario resulted in higher outlays of supplies than the crop expansion one after 1985.

Table 11. Projected Increases In Intermediate Purchases In Agricultural Sector Under the Crop Expansion Scenario (\$1,000 units in 1970 Dollars)

	Year			
	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
Increase	30,542	26,945	32,177	30,414

Thus, the scenario which emphasizes crop expansion does not have as stimulating an effect upon economic growth in the state of Minnesota as the livestock expansion alternative, whether measured in terms of gross changes in output, employment and earnings, or intermediate purchases for the economy.

However, a recent linear programming study (16) of how to best maximize an individual's farm earnings via pasture improvement on northern Minnesota farms suggests that the best use of related crop areas is in the production of high return crops such as wheat, sunflower, or grass seed rather than in expanded beef production.(16) Also, recent economic conditions--sagging real incomes and a growing export demand for crops--have been putting a cost-price squeeze on the beef enterprise while favoring cash crop production. Consequently, the second expansion path is the one more likely to be followed by farmers in northern Minnesota.

In this study improved management practices for beef producers were reviewed, the impact of their adoption on the income of beef producers was estimated and two alternative adjustments of northern Minnesota agriculture to these improved management practices were analyzed.

Increased productivity of northern Minnesota pastureland can initiate development along one of two lines--either (1) a significant expansion in the size of Minnesota's beef cow herd, or (2) a moderate expansion of the beef cow herd combined with a significant expansion of crop production. Either expansion path would significantly increase farm earnings in northern Minnesota as well as the general level of economic activity. Computer projections based on historical relationships between the agricultural sector and the rest of the economy suggest that the larger beef herd expansion might provide more economic benefits to the total economy of the state since livestock farming generates more non-farm economic activity than crop farming. However, other studies suggest that net farm earnings would likely be greater under the crop adjustment alternative--thus this is the one more likely to be observed during the next two decades as farmers improve both pasture and livestock management practices.



In conclusion, this study has found that the Minnesota Agricultural Extension Service project known as the UGL beef project has already had a significant economic impact on those beef producers who have adopted the improved management practices demonstrated in that project. And, if educational programs can be continued that will bring about fairly complete adoption of improved practices by northern Minnesota beef producers during the next decade, the total impact upon the state's economy will be 3 to 4 times as great as the direct impact upon agricultural sales. This suggests that the benefits of an expanded Extension education program with these objectives would greatly outweigh the costs of such a program.

FOOTNOTE

<sup>1</sup> The Minnesota Beef Cow-Calf Industry, Extension Bulletin 438, Agricultural Extension Service, University of Minnesota, 1978.

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<sup>3</sup> P.R. Hasbargen, R.H. Craven and N.P. Martin, "Pasture Demonstration Program For Beef: Economic Considerations," International Forage and Grassland Proceedings, Dept. of Agricultural and Applied Economics, University of Minnesota, 1981.

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<sup>5</sup> The North Central Quarterly, North Central Experiment Station, Grand Rapids, Minnesota, Volume 50, Number 2, April 1980.

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