

Impact of alfalfa and fertilizer on pastures:

Economics

Introduction

Adding alfalfa and/or fertilizer to grass-based pastures can improve yield and productivity. However, adding fertilizer alone or in combination with alfalfa may not improve profitability if production is limited by factors such as moisture.

Research Study

A ten-year grazing study was conducted at the Agriculture and Agri-Food Canada Brandon Research Centre from 1994-2004. The goal was to assess the economic outcome of different pasture management strategies. In the spring of 1994, pastures were established on a Souris fine sandy loam. The study used rotational grazing on four combinations of pasture type and fertilizer management. There were two different pasture types (100% grass or mixed alfalfa-grass) and two different fertilizer treatments (no fertilizer, or spring fertilization to full soil test recommendation levels). This resulted in a total of four treatments, shown in Table 1.

Table 1. Pasture Types and Fertilizer Treatments used in the Study

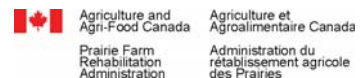
1) Meadow bromegrass No added fertilizer	3) Meadow bromegrass + Alfalfa No added fertilizer
2) Meadow bromegrass + Fertilizer	4) Meadow bromegrass + Alfalfa + Fertilizer

The grass-only pastures were seeded with 10 lb/acre 'Paddock' meadow bromegrass. The mixed alfalfa-grass pastures were seeded with 7 lb/acre 'Paddock' meadow bromegrass and 3 lb/acre 'Spredor II' alfalfa. Starting in 1995, fertilizer was surface-applied as a dry blend prior to grazing each spring. The concentration of each nutrient in the blend was based on soil samples collected the previous fall.

The economic performance of the four different pastures was compared based on annual net revenue. Net revenue was calculated by subtracting all production and input expenses from gross revenue. Gross revenue was assumed to be \$0.43 per pound of animal gain, which was the typical revenue for custom grazing during the last few years of the study.

Production and input expenses included: labour, variable costs (i.e., seed, fertilizer, chemical, fuel and oil, repairs, land taxes, interest cost on variable inputs, and miscellaneous), and fixed costs for machinery and livestock handling systems (depreciation, interest on investment, insurance and housing). Annual input expenses included the cost of pre-planting activities, fertilization, planting, harvesting, and transportation. Farm-level machinery and equipment were used to estimate costs. The labour cost and lifespan of machinery for farm operations was calculated according to the machinery work rate per acre (Saskatchewan Agriculture, Food and Rural Revitalization 2004 &

THANK YOU TO OUR SPONSORS WHO MADE THIS PUBLICATION POSSIBLE:





Economics

2007). The lifespan of infrastructure, determined from published values and other sources, was used to calculate infrastructure depreciation and interest on investment. No allowance was made for interest costs associated with land equity.

Study Results

Forage Yield and Animal Gain

Adding fertilizer and/or alfalfa to grass-based pastures improved pasture productivity. Table 2 shows that the highest forage yield and animal gain were achieved in the fertilized alfalfa-grass pastures.

Table 2. Forage Yield and Animal Gain Averaged over the 10-year Study

Pasture Management Strategy	Forage yield (tons/ac)	Animal gain (lb/ac)
Unfertilized grass-only	1.1	99
Fertilized grass-only	2.2	217
Unfertilized alfalfa-grass	1.7	156
Fertilized alfalfa-grass	2.4	224

Economic Analysis based on 2007 Fertilizer Prices

Table 3 shows the annual fertilizer cost for the four pastures, based on spring 2007 fertilizer prices (\$0.50/lb N, \$0.38/lb P, \$0.22/lb K, \$0.34/lb S). Fertilizing either grass-only or alfalfa-grass pastures at least doubled the forage yield compared to unfertilized grass-only pastures. However, the yield increase in alfalfa-grass pastures was achieved with less than half the cost required to fertilize grass-only pastures. Despite these yield increases, both fertilized pastures resulted in a net loss when 2007 fertilizer prices were used to calculate net revenue.

Table 3. Annual Fertilizer Cost Based on 2007 Fertilizer Prices

Pasture Management Strategy	Annual Fertilizer Cost (10-year Average)
Unfertilized grass-only	\$0
Fertilized grass-only	\$64.75
Unfertilized alfalfa-grass	\$0
Fertilized alfalfa-grass	\$31.16

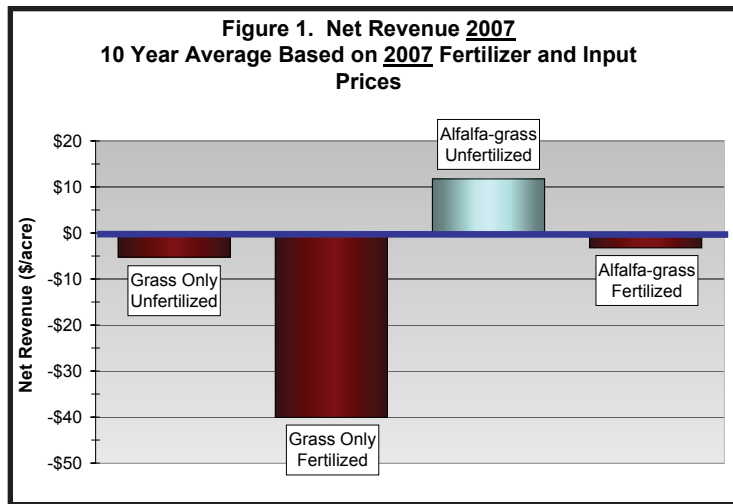
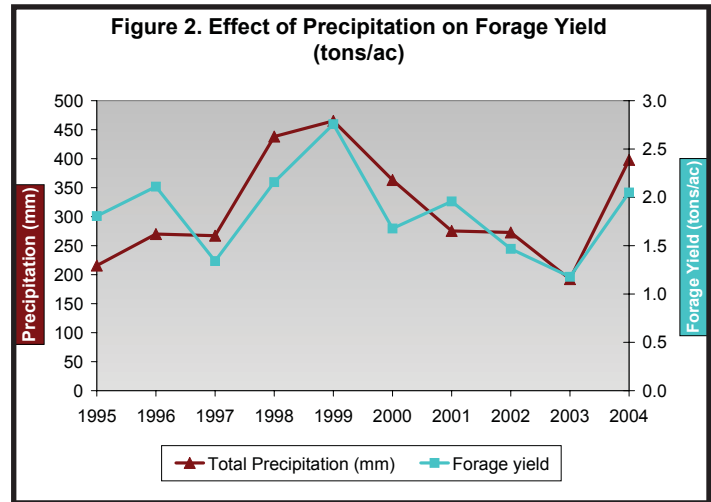
Figure 1 (next page) shows the net revenue for the four pastures based on spring 2007 fertilizer and input prices. The bars above the horizontal line show a net profit, while the bars below the line show a net loss.

Averaged over the 10 years of the study, the only pasture improvement strategy with a net profit was the unfertilized alfalfa-grass pastures, which had a profit of \$11.75/acre. The other three pasture improvement strategies resulted in a net loss. It should be noted that all the pastures had fairly similar fixed costs. While the unfertilized grass-only pasture was the lowest-cost grazing system, it was not the most profitable because the fixed costs were high, relative to the low level of productivity.

Economics



The highest net loss (\$40.06/ac) was for the fertilized grass-only pastures, even though adding fertilizer doubled the forage yield compared to unfertilized grass-only pastures. Therefore, fertilizing grass-only pastures to full soil test recommendations is not advised. Fertilizing alfalfa-grass pastures to full soil test recommendations resulted in a yield increase of 0.7 tons/acre each year compared to unfertilized alfalfa-grass pastures. Despite this yield increase, fertilizing alfalfa-grass pastures to full soil test recommendations resulted in a net loss of \$3.24/ac.



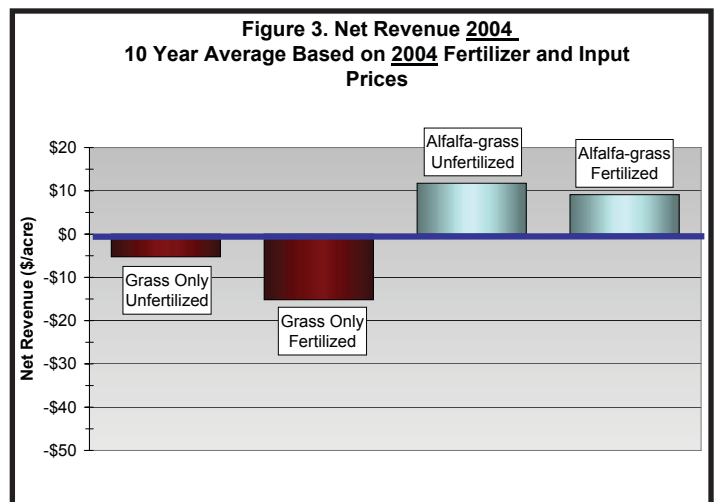
Based on 2007 fertilizer prices, every pasture management strategy resulted in a net loss for at least two years of the ten-year study. Even the most profitable strategy, the unfertilized alfalfa-grass pastures, had a net loss in two out of ten years. In comparison, a net loss was seen in fertilized alfalfa-grass pastures for five out of ten years, in unfertilized grass-only pastures for six out of ten years, and in fertilized grass-only pastures for nine out of ten years.

Precipitation strongly affected net revenue. Between 1998 and 2000, most of the pastures showed a net profit. Figure 2 shows that during these years, higher precipitation tended to result in higher forage yield.

Economic Analysis based on 2004 Fertilizer Prices

The results of the economic analysis depend heavily on fertilizer price. As a comparison to 2007 costs, calculations were done using 2004 fertilizer prices (\$0.33/lb N, \$0.12/lb P, \$0.12/lb K, \$0.26/lb S), which were lower than in 2007. The year 2004 was chosen because it was the last year of the study.

Figure 3 shows that with 2004 fertilizer and input prices, both of the alfalfa-containing pastures generated a net profit. The unfertilized alfalfa-grass pasture was still economically the best choice (\$11.75/ac profit). However, under this scenario, the fertilized alfalfa-grass pasture also produced a net profit (\$9.11/ac).



Economics

Both of the grass-only pasture pastures resulted in a net loss. Fertilizing grass-only pastures was still economically the worst option, followed by unfertilized grass-only pastures. Therefore, while actual numbers for profitability may be heavily influenced by variable costs, especially fertilizer costs, the relative profitability of the pastures did not change.

Conclusion

While converting poorer soils from cropland to perennial forage grasses may improve soil health and reduce erosion, it is not always profitable unless pasture improvements are made. These improvements include adding nutrients as either commercial fertilizer or supplemental feed, or simply by adding alfalfa or other nitrogen-fixing legumes at the time of seeding.

Pasture improvements can increase forage yield, but superior yields do not necessarily translate into increased profits. Fertilizing grass-only or alfalfa-grass pastures to full soil test recommendations improved pasture productivity, but did not improve profitability compared to unfertilized pastures. Fertilizing grass-only pastures resulted in the highest net loss of any pasture management strategy in this study. Adding alfalfa at the time of seeding, with no added fertilizer, was economically the best pasture improvement strategy in this study.

Because of moisture limitations, adding commercial fertilizer to full soil test recommendations is probably not economically justifiable in most years, especially with the rising cost of fertilizer. However, improved productivity could probably be achieved with much lower rates of fertilizer. Further research is needed to determine what level of fertilization would be optimal.

Researchers: Dr. Mohammad Khakbazan, Dr. Shannon Scott, and Clayton Robins, Agriculture and Agri-Food Canada, Brandon Research Centre.

Writer: Orla Nazarko, Greenstem Communications.

Editor, Design: Corie Arbuckle, Corie Communications.

Sources:

Saskatchewan Agriculture, Food and Rural Revitalization. 2004 & 2007. Farm Machinery Custom and Rental Rate Guide. Sustainable Production Branch, Saskatchewan Agriculture and Food, Regina, SK.

Manitoba Agriculture, Food, and Rural Initiatives. 2004 & 2007. Guidelines for Estimating Crop Production Costs.

For more information contact: Dr. Shannon Scott
Agriculture and Agri-Food Canada/Agriculture et Agroalimentaire Canada
Brandon Research Centre
Telephone (204) 578-3605
E-mail: sscott@agr.gc.ca

This technical bulletin is part of a series that have been developed as a result of this collaborative study.