Why are Tame Hay Yields Declining in Saskatchewan?

P.G. Jefferson[1] and F. Selles[1]

[1]Agriculture and Agri-Food Canada, Semiarid Prairie Agricultural Research Centre, P.O. Box 1030, Swift Current, SK S9H 3X2

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Abstract

Provincial agricultural production statistics show that grain crop yields have generally increased over the past 35 years while tame hay yields peaked in 1980 and have since been in decline. Weather data from 16 sites across Saskatchewan for the April, May, and June (AMJ) period were examined to explain this decline. As expected, precipitation during AMJ was positively correlated to hay yield but temperature was not. Hay yield was subsequently expressed as water use efficiency (WUE) based on published annual mean hay yield and AMJ precipitation. The WUE exhibited a negative correlation to year since 1980 and to the harvested hay acreage per year. After de-trending both WUE and harvested hay acreage for the year effect, the residual variation in both variables was still negatively correlated. We propose that older and lower-yielding hay fields are being harvested more frequently over the last two decades to provide feed for a growing Saskatchewan beef cow herd. This suggests that forage extension efforts should focus on hay field rejuvenation and agronomic management for improved productivity.

Introduction

Annual provincial average grain yield of spring wheat, durum wheat, barley, and canola in Saskatchewan have been increasing since 1967 (SAFRR 2004). However, the provincial average tame hay yield increased from 1967 to about 1980 but has been declining since then (Figure 1; $R^2 = 0.37$, $P<0.01$). We examined weather and statistical data to explain this decline.

The provincial beef cow herd has been increasing since 1985 and has recently reached a number not seen since 1975 (Figure 2). With a reduced mature cow culling percentage in 2003 and 2004 due to the USA border closure to exported live beef animals, these numbers will continue to climb into 2005.

The acreage of harvested hay has increased since 1980 and is now larger than it was in 1975 (Figure 3).

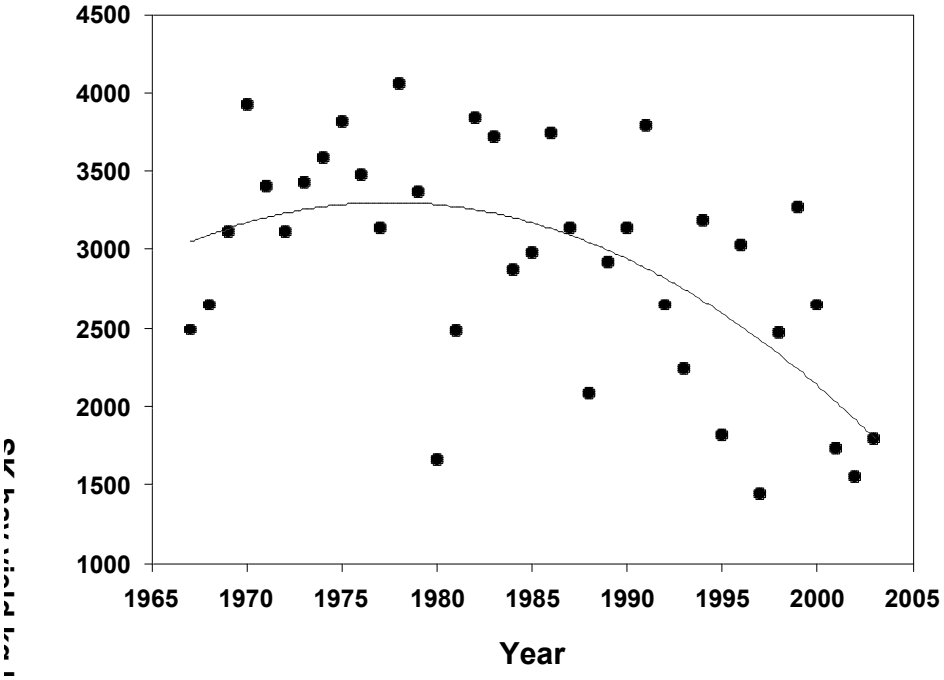

Figure 1. Saskatchewan mean tame hay yield by year since 1967.

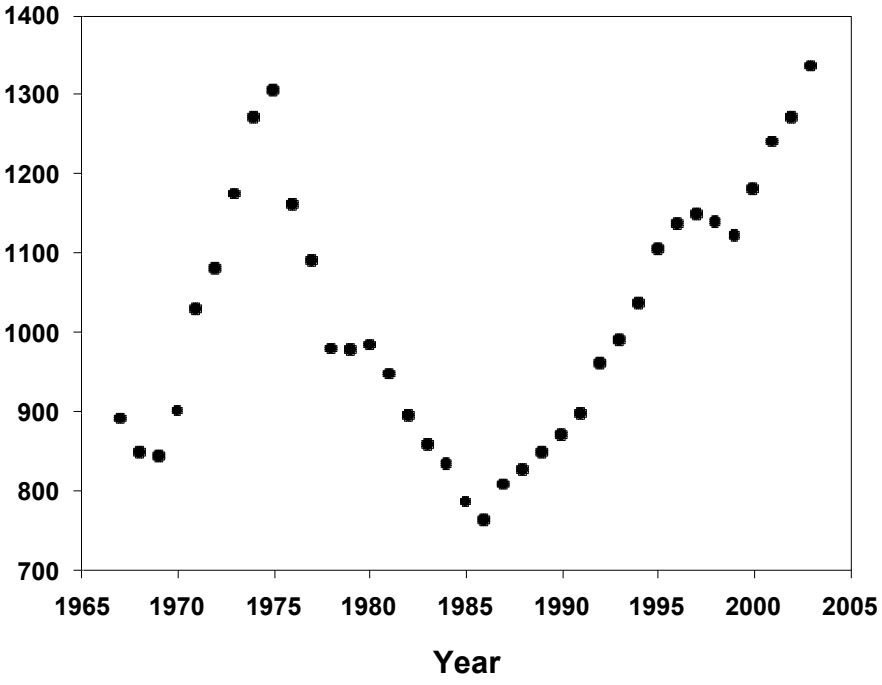

Figure 2. Number of beef cows (thousands) on farms in Saskatchewan by year since 1967.

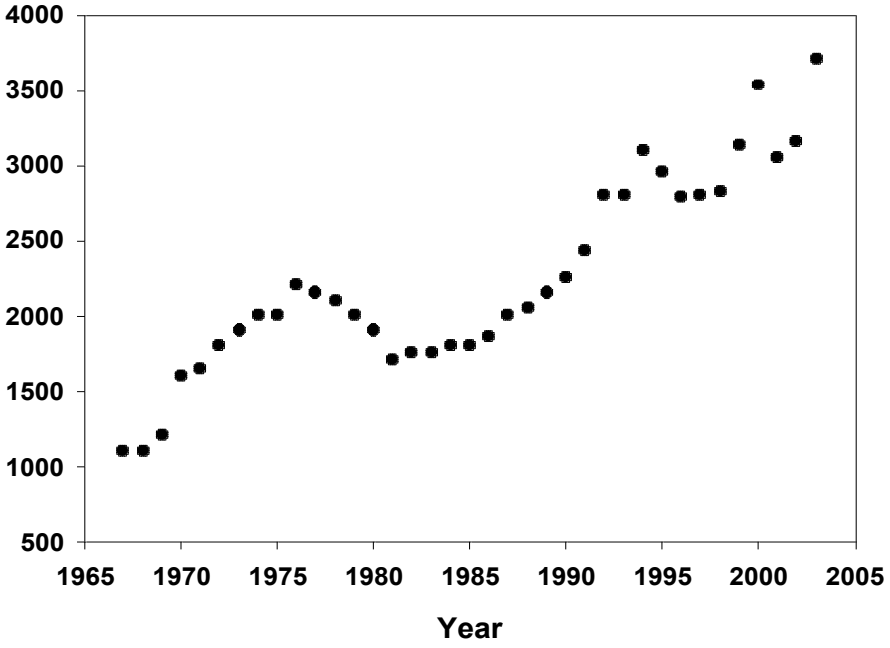

Figure 3. Tame hay acres harvested (thousands) per year in Saskatchewan since 1967.

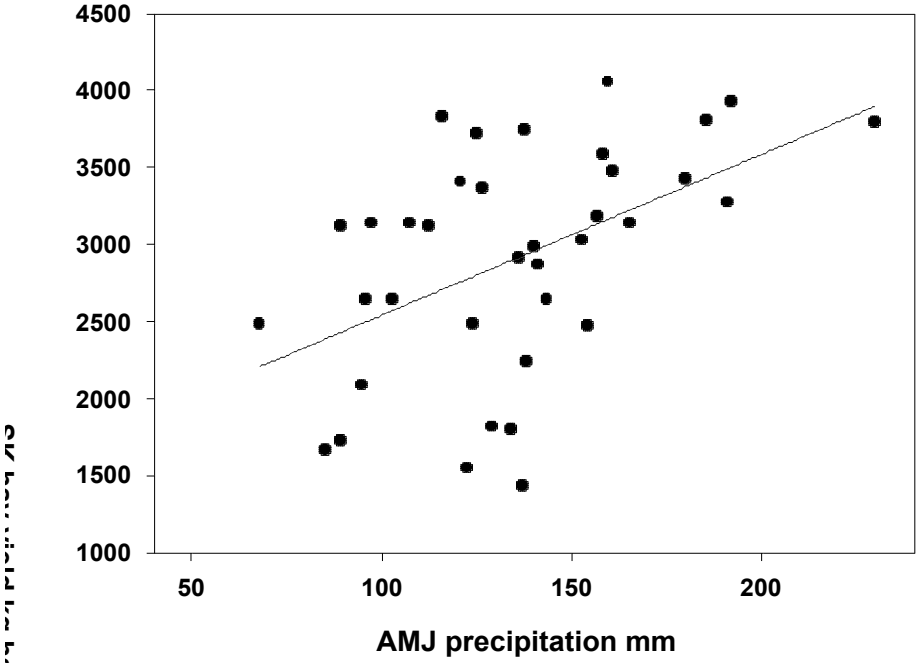

Figure 4. Provincial average tame hay yield in relation to April, May, and June total precipitation averaged over 16 sites.

Statistics:
Provincial average tame hay yield, beef cow number, harvested acres of tame hay from 1967 to 2003 were obtained from the 2003 Agricultural Statistics bulletin (SAFRR 2004). Hay yield was expressed as water use efficiency (WUE), hay yield divided by the total April, May and June (AMJ) precipitation or kg ha^{-1} mm^{-1}. Hay yield per mature animal was calculated from (yield * acreage)/(total cattle – calves – steers).

Weather data:
Daily precipitation amount and temperatures (minimum, maximum, and mean) were obtained (Environment Canada 2004) for April, May, and June at 16 locations across Saskatchewan for 1967 to 2003. They were: Broadview, Estevan, Kindersley, Lloydminster, Maple Creek, Meadow Lake, Moose Jaw, Nipawin, North Battleford, Prince Albert, Regina, Rosetown, Saskatoon, Swift Current, Wynyard, and Yorkton. The sites were chosen to for completeness of weather records for the period as well as to represent soil zones of the agricultural region of the province. Total AMJ precipitation and mean temperature for the province was determined.

Results

The provincial mean tame hay yield was correlated to total April, May, and June (AMJ) precipitation (Figure 4; $R^2 = 0.24$, $P<0.01$). This relationship has been shown in previous research results from Swift Current for alfalfa (Jefferson and Cutforth 1997) and crested wheatgrass (Jefferson, unpublished). It is noteworthy that such a relationship was also evident in provincial average yield data which represents a large increase in spatial scale. There was no relationship between hay and temperature (data not shown). Provincial mean precipitation and temperature have not changed over time (data not shown).

The WUE of tame hay average yield declined linearly since 1967 (Figure 5; $R^2 = 0.38$, $P<0.01$). One of the main agronomic factors affecting WUE is the level of soil nutrients available to the crop, particularly N. Most producers do not fertilize their forage stands and most hay fields are dependent on soil nutrient supplying power. The concentrations of soil N for a crested wheatgrass monoculture harvested for hay can be depleted to very low levels even when it is fertilized annually with sufficient N to offset crop removal (Selles et al. 2005).

The WUE of tame hay has declined as the provincial beef cow herd has increased (Figure 6; $R^2 = 0.34$, $P<0.01$). The WUE of tame hay has declined as the number of hay acres harvested has increased (Figure 7; $R^2 = 0.50$, $P<0.01$). After de-trending both variables for the year effect, this relationship was still significant ($P<0.01$ data not shown).

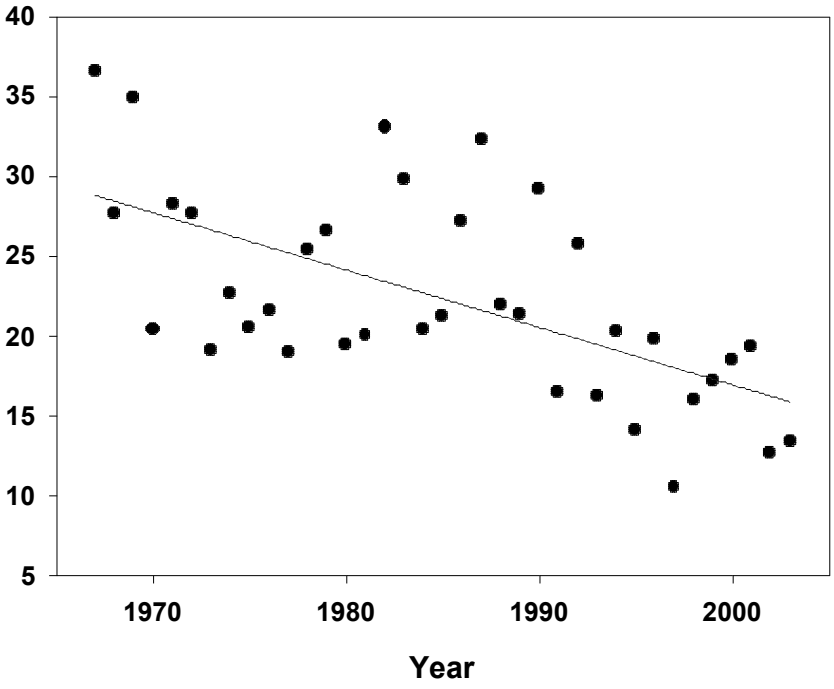

Figure 5. Water use efficiency of provincial average tame hay yield by year since 1967.

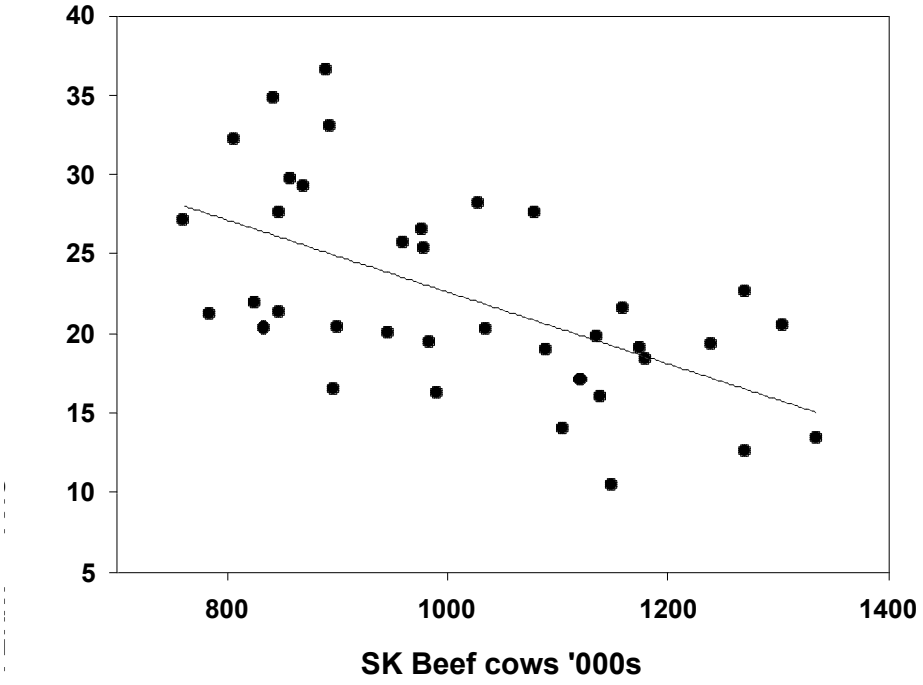

Figure 6. Water use efficiency of provincial average tame hay in relation to the number of beef cows (thousands).

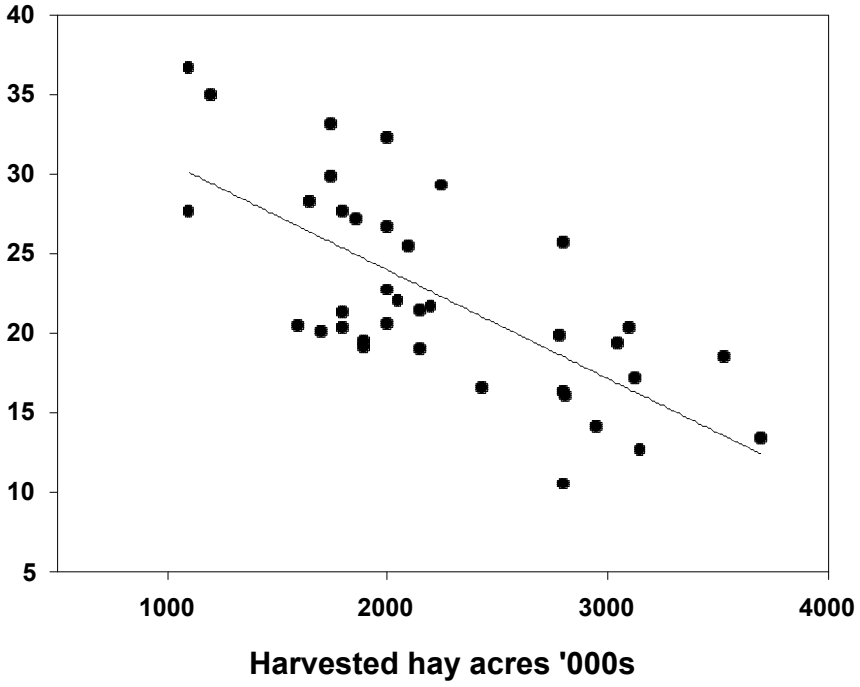

Figure 7. Water use efficiency of provincial average tame hay in relation to the number of tame hay acres harvested (thousands).

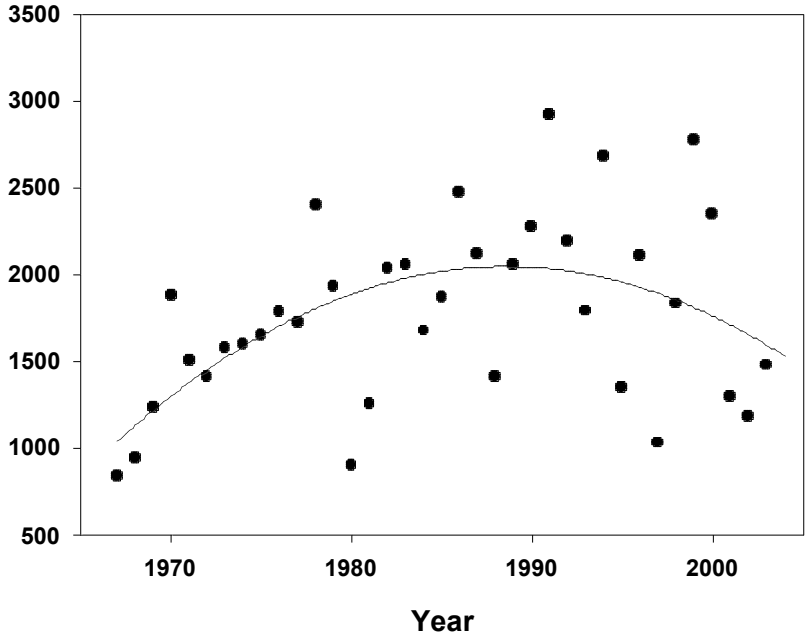

Figure 8. Hay for each mature ruminant animal (beef and dairy cows, bulls, and replacement heifers) by year since 1967.

As more and more hay acres were harvested to meet the over-winter feeding requirements of an increasing beef cow herd, hay yield and hay WUE declined over time. Older stands of tame hay are lower yielding than newly established stands (Jefferson and Cutforth 1997). As demand for hay increases, the stand life of hay fields may be extended despite declining productivity. The acreage of tame hay has been increasing over the past 20 years in Saskatchewan but much of this increased hay acreage was targeted on marginal crop land as a soil conservation initiative (Permanent Cover Program I and II; Green Cover Program). Since forage production would be similarly limited by problem soils, we speculate that these programs have contributed to the decline in average tame hay yield.

Tame hay yield per mature animal peaked about 1990 in Saskatchewan and has been declining for the last decade (Figure 8; $R^2 = 0.28$, $P<0.01$). It also appears to be more variable over the last 15 years than it was prior to 1990. This variable is interesting since it combines forage yield variation with the changing demand for hay as beef and dairy herds have changed over time. The large variation in tame hay yield per mature animal recently may help explain the high interest in alternative feeds such as annual crops cut as "green feed" forages, crop residues, swath grazing to extend the fall and winter grazing period and opportunity feeds such as screenings and downgraded grain crops.

Speculation

While this approach does not allow us to test specific hypotheses, it suggests some opportunities for additional research and has implications for forage extension.

1. Hay yield decline is not associated with changes in weather since 1967.
2. Hay WUE on a provincial basis is declining and this may be related to low fertility status as most hayfields are not fertilized.
3. As acreage of seeded forage has increased since 1980, yield has declined. This might be due to the government programs to subsidize conversion of the most marginal annual cropland to forage production.
4. As beef cow herd has increased, the demand for hay has resulted in more older, low yielding hayfields being harvested than prior to 1980. The net result is that we need more hay acres than ever to keep a cow.

Take home message

More hay stand rejuvenation is needed and a government policy change to support seeding forages on more productive soil types is needed to reverse the decline in hay yields. We need more hay acres than ever before to support the post-BSE-crisis beef cow herd.

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