Planned Grazing

RD 1

Measuring the impact of planned grazing on forage, soil, and livestock productivity

Project Lead: **Pam Iwanchysko,** Livestock Specialist, Manitoba Agriculture and Resource Development

MBFI Location(s): Brookdale Farm

Collaborating Partners:
Dr. Terence McGonigle – Brandon University
Mae Elsinger – Range Biologist, Agriculture and Agri-Food Canada

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Background

Between 1870 and 1920 treaties were signed with Indigenous populations throughout Canada for European settlers to take over the land and practice agriculture with cultivation and for hunting. This lead to many agricultural producers becoming vulnerable to extreme weather events such as the drought of the 1930's. Poor production practices due to the evolution of an industrial, maximum based production model with intense inputs on their operations, had and has left them less profitable and sustainable.

Climate change has now also become a reality that current agricultural producers face, with increasing temperatures, longer growing seasons and more disruptive weather patterns. Producers need to become adaptive in their management techniques to be able to produce high quality products off of the land they manage, while still being profitable. The International Institute for Sustainable Development in their 2021 Farming for the Future Report, reported that agricultural greenhouse gas emissions (GHG) from agriculture in Canada are 12% of the national total. They also reported that 45% of the prairie GHG emissions are from animal production (primarily methane from cattle digesting grass as well as methane and nitrous oxide from manure management).

Reduction of these emissions is possible through beneficial management practices such as reducing nitrogen fertilizer use and changes in feed as well as practices such as rotational grazing. This three year applied demonstration showcased what benefits can be exemplified through the use of livestock on the landscape in a managed environment.

Planned grazing refers to the process of moving livestock from paddock to paddock in a pasture, at the correct time and for the correct duration. This allows the animals to fertilize the land, disturb and aerate the soil slightly, and trigger plants to re-grow faster and healthier. Managers using this type of system, subdivide their pastures into paddocks which enables them with the power of controlling the livestock movement. When done correctly, grazing in this way can actually increase biodiversity and slowly improve levels of soil organic matter through increasing soil microbial activity and over time, allowing for more litter accumulation on top of the soil. Reported benefits of plant diversity in grasslands include: increased forage production, greater ecosystem stability in response to disturbance, and reduced invasion by exotic species such as weeds[1].

Ranchers have a vested interest in managing for the best results in terms of production, profitability and sustaining natural resources on pasture[4]. Impacts of livestock on soil fall into two broad categories: first, the physical impact of the animal on soil as it moves around, and, second - the chemical and biological impact of the feces and urine that the animal deposits to soil[6].

Planned grazing allows managers to decide how long the animals will stay on a paddock, when they will move next and more importantly when they will return. It has been noted, that the absence of disturbances in grassland ecosystems results in a decline in species diversity and deterioration of physical structure[3]. Therefore there is a defined need to have some animal impact on the land to maintain a healthy ecosystem. The end result is one of the biggest opportunities to increase profit on the farm, while adding environmental resiliency to the farm through improved soil, animal and forage productivity and health. It is hypothesized that planned grazing (commonly referred to as intensive grazing or mob grazing) will increase soil, forage and ultimately animal health and production. However, this management style can require some time and resources to set up and manage, which is likely why it is not widely adopted yet. According to the Western Canadian Cow-Calf Survey[5] collected in 2014, "Intensive grazing was practiced by only 11 per cent of respondents on tame pasture and 2.7 per cent of respondents on native pasture." Planned grazing is designed to have short grazing periods, high stocking density and a full rest and recovery of the plants before being grazed a second time. Recovery periods are adjusted (60 to 90 d is targeted) based on monitoring forage growth, environmental conditions and animal performance.

Objectives

This demonstration project will provide a means of showcasing proper grazing management in order to promote the reduction and elimination of the practice of continuous grazing. It will demonstrate the positive impact of monitoring and managing the movement of animals, with the proper timing and duration, allowing for proper amounts of rest and recovery time for the plants and how that can actually rehabilitate the landscape.

This demonstration project will measure the estimated forage yield differences between the two grazing regimes, it will calculate the animal grazing days per acre and measure plant diversity between the two as well.

Finally the project will also calculate an economic analysis comparison of the two grazing systems and determine the financial impact proper planning and management can have on the potential profit for the forage and livestock operation.

Project Design and Methods

A grazing plan was developed to implement grazing of two herds of 25 cow-calf pairs each, to compare planned grazing to a conventional continuous grazing plan. Each herd was assigned paddocks which were lettered with the same letter (A-G) which corresponds to the same forage quality, and within those lettered paddocks, smaller paddocks of the same size for the planned herd. The continuous herd had the same amount of acres but there was no paddock division within any of the paddocks.

Pastures consisted of native forage (paddocks 12, 13, 14, 15, 16, 21, 22, 23) and a tame pasture mix (paddocks 1 to 11, 17 to 19 and 24 to 30) for the herds. Each herd had access to a combination of both tame and native species. The herds were assigned grazing according to a randomized complete block design to accommodate soil microbiological analysis research by Brandon University.

The tame pasture mix consisted of 45 per cent meadow bromegrass, 30 per cent orchardgrass, 10 per cent timothy, 10 per cent creeping red fescue and some additional cicer milkvetch was also added. The native pastures included western wheatgrass, northern wheatgrass, slender wheatgrass, green needlegrass, big bluestem, little bluestem, side-oat grama grass, switch grass and indian grass. Twenty-three paddocks, approximately four acres each, were set-up with temporary electric fencing on the perennial summer pastures, with a permanent two-strand electric wire around the perimeter for the planned herd with some additional 4 barbed wire fencing along a major highway, and continuous grazing occurred on the rest of pastures (Table 1.1). There was the same amount of pasture area for each of the herds.

Paddocks for McGonigle project INT 11	Planned herd paddock number(s)	Number of ac	Continuous herd paddock number(s)	Number of ac
A	1 – 4	16.8	5	16.8
B	7 – 11	18	14	18
C	12 – 13	8.1	7 – 8	9.9
D	15	5.7	16	5.1
E	17 – 19	10.8	20	10.4
F	21 – 23	10.4	24	9.7
G	25 – 28	21.1	30	20
Sum of acres		90.9		89.9

Table 1.1. Paddock treatment assignment and number of acres in each

Each of the paddocks on the planned grazing regime were approximately 1 acre in size. Some paddocks which were altered to become larger due to poor forage re-growth due to dry conditions, taking into account a 75 day rest period for the next growing season when environmental conditions changed.

All individual animals were weighed at the beginning of the trial and then monthly to get a measurement of the rate of gain and they were body condition scored (BCS). Animals and pastures were monitored for health and growth and were managed according to the forage growth in the paddocks. A grazing plan was compiled and used for the detailed management of the grazing treatments. Cows were offered water through a solar-powered watering system that was developed on the entire section with an above ground pipeline that reached all of the paddocks through a trough that moved with the animals.

56 Grazing cages were randomly placed throughout the grazing pastures for estimated yield and residual measurements throughout the growing seasons and samples were collected prior to grazing at the end of May and beginning of June, mid-season grazing on July 10, 2019 and residual samples were collected at the end of grazing on October 3, 2019 and on May 25, July 7, and October 14, in the 2020 grazing season. The 2021 grazing season samples were collected on June 3, July 8 and October 4, 2021.

Results

Grazing was scheduled to commence when the majority of the grasses had reached the three leaf stage. Monitoring started at the beginning of May and occurred weekly throughout all the paddocks. Mature leaves were counted from each stem on different species within each paddock and an average was determined. Each leaf was determined to be mature when each leaf had developed a collar. After the third-leaf stage it is noted that the plant has captured enough energy reserves to regrow after the plant has been defoliated. Planned paddocks were ready at this stage on May 29, 2019. The continuous pastures were not identified to have reached the three leaf stage until June 12, 2019. An additional 14 days of grazing occurred on the planned paddocks in the spring of 2019. The same scenario was presented in 2020 where the planned herd was placed on pasture May 26, 2020 and the continuous pastures were not ready to be grazed until June 4, 2020. The 2021 grazing season started off very cold and dry. Grazing began on the planned paddocks on June 7 and on June 11 for the continuous herd. An additional 5 days grazing was allocated for the planned herd in the 2021 spring grazing.

Estimated yields were taken mid-season. Four grazing cages were placed within each treatment (specific paddock letter) on each grazing regime. A ¼ meter square sample was taken within each grazing cage, weighed, and then dried in an air drier. The sample was then re-weighed to determine the dry matter content of the sample. Estimated yields were then averaged amongst the 4 samples within each lettered paddock. Residual samples, after the grazing was completed, were collected in the same manner and added to the total yield for those paddocks. All residual samples were taken after the planned cows were taken off pasture on September 30, 2019. The continuous cows were taken off trial on September 3, 2019, thus the planned herd had an additional 27 days of grazing in the fall, thus having a total of 41 additional days of grazing in the 2019 season. In the 2020 grazing season, the continuous cows were taken off on September 21 and the planned herd once again had an additional 18 days in the fall grazing season with the additional 5 days in the spring for a total of 23 grazing days in 2020. The 2021 grazing season was much the same with the continuous cows coming off 20 days earlier than the planned herd with little to no residual left on those paddocks on September 14, 2021. The planned herd came off trial on October 4, 2021. A total of 25 additional grazing days was accounted for in the 2021 grazing season. There was a labor shortage at the research farm in the fall of 2021 and the continuous cows were to come off trial earlier.

Estimated Peak Yield for Paddocks within the Planned and Continuous Grazing Systems in July 2019, 2020 and 2021 Growing Seasons.

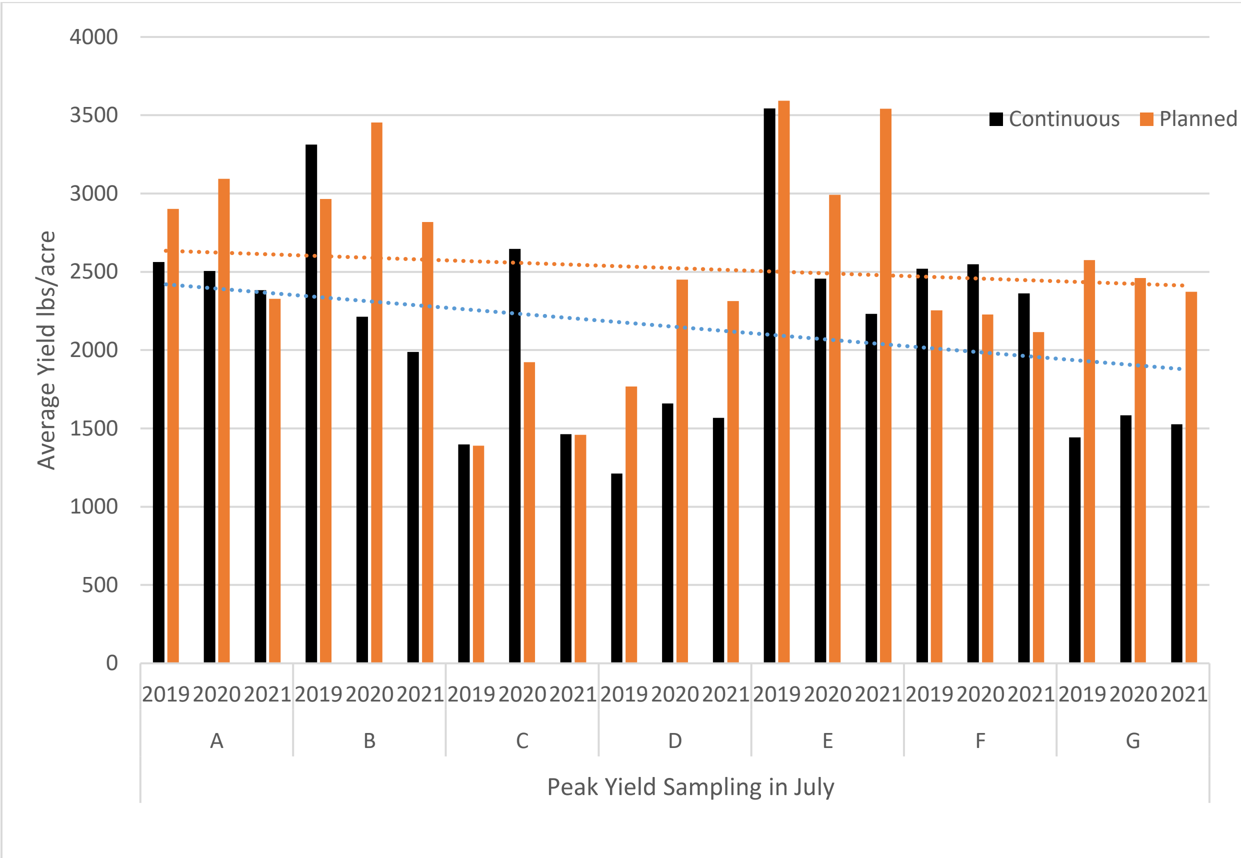

Figure 1.1. Estimated Peak Yield for paddocks within the planned and continuous grazing systems in July 2019, 2020 and 2021 growing seasons.

Figure 1.1 showcases the differences that arose through sampling at the peak period of growth under the grazing cages in each of the paddocks in each year in early July. In the spring of 2019, 2020 and 2021, the spring periods were all dry and cool. Conditions were not favorable for rapid forage development. Assessments were completed on a weekly basis starting at the beginning of May to determine when the grasses within the species mixtures would be ready for grazing at the targeted 3 leave stage. Following that determination, samples were taken from beside the randomized grazing cages, prior to grazing, and it was determined that the paddocks that had the 75 day rest period in the previous year were the quickest to reach the 3 leaf stage. Grazing began on the E paddocks in 2019 and on the F paddocks on 2020 and in the G paddocks in 2021 in 1 acre sub-divided paddocks and were moved daily throughout the other paddocks based on readiness. These paddocks were deliberately un-grazed the year before in order to start grazing in that paddock in the spring of 2019, 2020 and 2021 respectively. The native planned paddocks were not anywhere near the 3 leaf stage in May or June and the estimated yield was also not favorable for grazing either and were therefore grazed near the end of the first over grazing regime.

Figure 1.1 also exhibits the targeted increased production over all the planned paddocks relative to the continuous paddocks. Over the three year period there was approximately 500 more lbs per acre on the planned paddocks. The response seems less desirable on the named native paddocks. It should be noted that these paddocks are in relatively low areas of the entire pasture and historically have been under water. The species composition is relatively unpalatable and the cattle spend a small amount of time in these paddocks based on yield estimates. The intent would be that the species composition may change over time relative to the grazing management but we have not seen significant changes to date. The C and D paddocks are only grazed once during the entire growing period. Average 2019 yield for the planned paddocks was 2590 lbs. per acre relative to 2339 lbs. per acre on the continuous and 2931 lbs per acre on the planned and 2259 lbs per acre on the continuous in 2020 on the peak yield sampling date, where the samples were taken from the middle of the randomly placed grazing cages. In 2021 again it was much of the same with the average peak yield at 2419 lbs. per acre and 1931 lbs. per acre for the planned and continuous paddocks respectively. It was noted however that the D planned paddocks were responding to increased rest and recovery and increasing yield over the 3 year trial. The trend lines also show an overall decrease in production partly due to the increasingly dry conditions that prevailed over the three years but it was also greater and may have been due to the mismanagement of the livestock in the continuous treatments. Average yield was approximately 500 lbs per acre more on the planned grazing over the three years.

Finally, residual measurements were taken on October 3, 2019 when all grazing ceased. It should also be noted that the residual measurements were taken for all paddocks on the same day but grazing was complete on the continuous paddocks 27 days prior to the planned herd in 2019 and 18 days earlier in 2020 and 20 days in 2021. This may in fact have skewed the residual results due to the additional moisture that was received in the later part of the summer and early fall in 2019 and also in 2021 – see Figure 1.2. Grazing was ceased somewhat earlier than anticipated due to another research project where the continuous cows were required from the continuous cow herd and residual measurements appear to be higher on the continuous paddocks. Additional recovery took place after precipitation and warmer temperatures prevailed after they were taken off of those paddocks. However residual measurements were much higher on the planned paddocks overall. Average residual for the planned paddocks was 684 lbs. per acre relative to 375 lbs. per acre on the continuous and 2677 lbs per acre on the planned and 1827 lbs per acre on the continuous in 2020 on the residual sampling date, and 1466 lbs per acre on the planned and 607 lbs per acre on the continuous in 2021, which once again the samples were taken from beside the grazing cages.

Finally, residual measurements were taken on October 14, 2020 after grazing ceased. It should also be noted that the residual measurements were taken for all paddocks on the same day but grazing was complete on the continuous paddocks 18 days prior to the planned herd. This may in fact have skewed the residual results but the same protocol was used as per the year prior. Once again residual measurements were higher in the paddocks that were targeted for grazing in 2021 as those paddocks were only grazed once with the intention to graze them first in 2021. Residual measurements overall in 2021 were only 607 lbs. per acre on average over all the continuous paddocks compared to 1466 lbs. per acre on average for the planned paddocks at the conclusion of the trial.

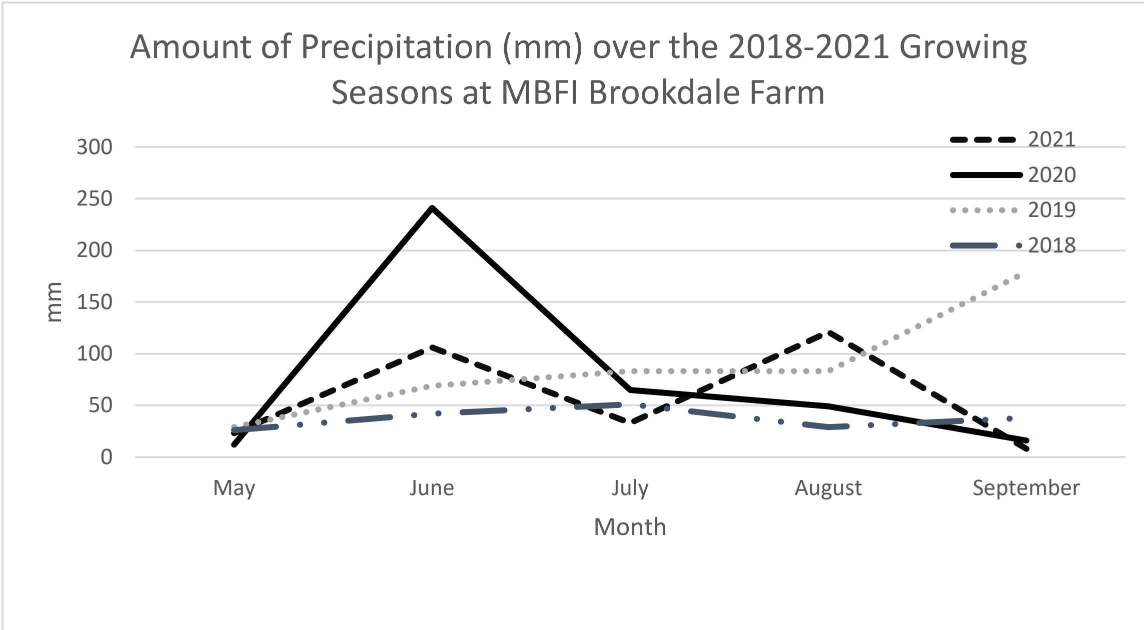

Figure 1.3 Total precipitation received at the MBFI Brookdale Farm during the 2018-2021 growing seasons.

Animal performance was measured and recorded. There was relatively no difference in terms of average daily gain on either of the herds within the trial. Planned cows and calves were not able to selectively graze because of being moved every day so therefore it was expected that gains would not be equivalent to the continuous herd, where they were able to select forage to their liking. The planned herd was on trial for an additional 41 days in 2019 and 23 days in 2020 and 25 days in 2021 and the planned calves did gain additional pounds for the additional days on trial. Particularly of interest is that the planned calves went on trial at an average of 138 pounds and came off at 458 pounds, an average gain of 2.5 pounds per day. Continuous calves went on later in the grazing season at 182 pounds and came off at only 421 pounds an average of 2.9 pounds per day in 2019. The planned calves gained 3.55 pounds per acre and the continuous calves gained 2.65 pounds per acre. In 2020 they went on trial at an average of 169 pounds and came off at 474 pounds, an average gain of 2.2 pounds per day in 2020. Continuous calves went on later in the grazing season at 176 pounds and came off at 443 pounds an average of 2.3 pounds per day. All cows maintained body condition throughout the trial. 2021 again was another year of the same performance with the planned calves going on trial at 156 pounds and coming off at 441 pounds, gaining 2.34 lbs. per day and the continuous calves going on at 176 pounds and coming off at 387 pounds gaining at 2.21 lbs,. per day.

Pasture Productivity was measured by yield as well as animal unit months per acre (AUM/acre). Knowing how much forage an animal needs is the first step in determining how many animals can be supported on the land available. The amount of forage required by one animal unit (AU) for one month is called an Animal Unit Month (AUM). One animal unit is defined as a 1,000 lb. (450 kg) beef cow with or without a nursing calf with a daily requirement of 26 lb. (11.8 kg) of dry matter forage. Therefore, one AUM is equal to 780 lbs (355 kg) of dry matter forage (30 days X daily forage requirement). The following chart summarizes the AUM's per acre for the paddocks within the trial. Not surprisingly the AUM's per acre on the planned paddocks were more than double that of the continuous pasture supplying more forage throughout the grazing season and allowing the animals to remain on pasture longer. Values which are highlighted were grazed for two rotations in that year. Overall, there was a 28% increase in productivity in 2019 and a 16% increase in 2020 and 20% more in 2021 in the planned over the continuous grazing management strategies.

Average Animal Unit Months per acre on the Planned and Continuous Grazing Paddocks at the Brookdale MBFI farm.			
Paddock	**AUM/Acre 2019**	**AUM/Acre 2020**	**AUM/Acre 2021**
A	1.31	**2.87**	1.28
B	**2.57**	**2.24**	1.48
C	1.04	1.21	1.22
D	1.07	1.01	1.11
E	**2.95**	**2.25**	**3.33**
F	1.01	1.05	**2.12**
G	**2.54**	1.18	**2.32**
Continuous Pasture	1.28	1.42	1.08

Table 1.2 Average Animal Unit Months per acre on the Planned and Continuous Grazing Paddocks at the Brookdale MBFI farm.

Plant species composition was also analyzed across the paddocks in 2019. For each of the 14 experimental units, seven random points were taken. At each random point, 20 pins were dropped. Therefore 140 pins per unit, giving 140 * 14 = 1960 pins per year to determine percentage cover of plant species for each paddock. A pin-frame scoring system[1] is not constrained to a maximum of 100%, because multiple plant contacts can be scored for any given pin. The pin frame was lowered into the vegetation and enumerated data every time a plant part touched a pin. Percent cover was determined from these counts by recording the total number of counts in a plot for a particular plant species and dividing by the total number of pins. The pins were small (1 mm) in diameter.

The planned paddocks showed better composition of desirable species such as alfalfa, smooth brome and milkvetch as noted in Figure 1.4. Kentucky bluegrass and meadow brome grass as well as white aster (less productive and desirable species) appeared to be the dominant species in the continuous pastures. Multiple paddocks in the continuous pastures were showing signs of degradation with regards to soil exposure and lack of ground cover. Other notable species encroaching on specific paddocks included absinthe wormwood and dandelions on the continuous paddocks. These visually striking plants or a locally more abundant plants may actually be found to not contribute very much to cover over the broader landscape and were only recorded with a small score using the pin scoring system.

C

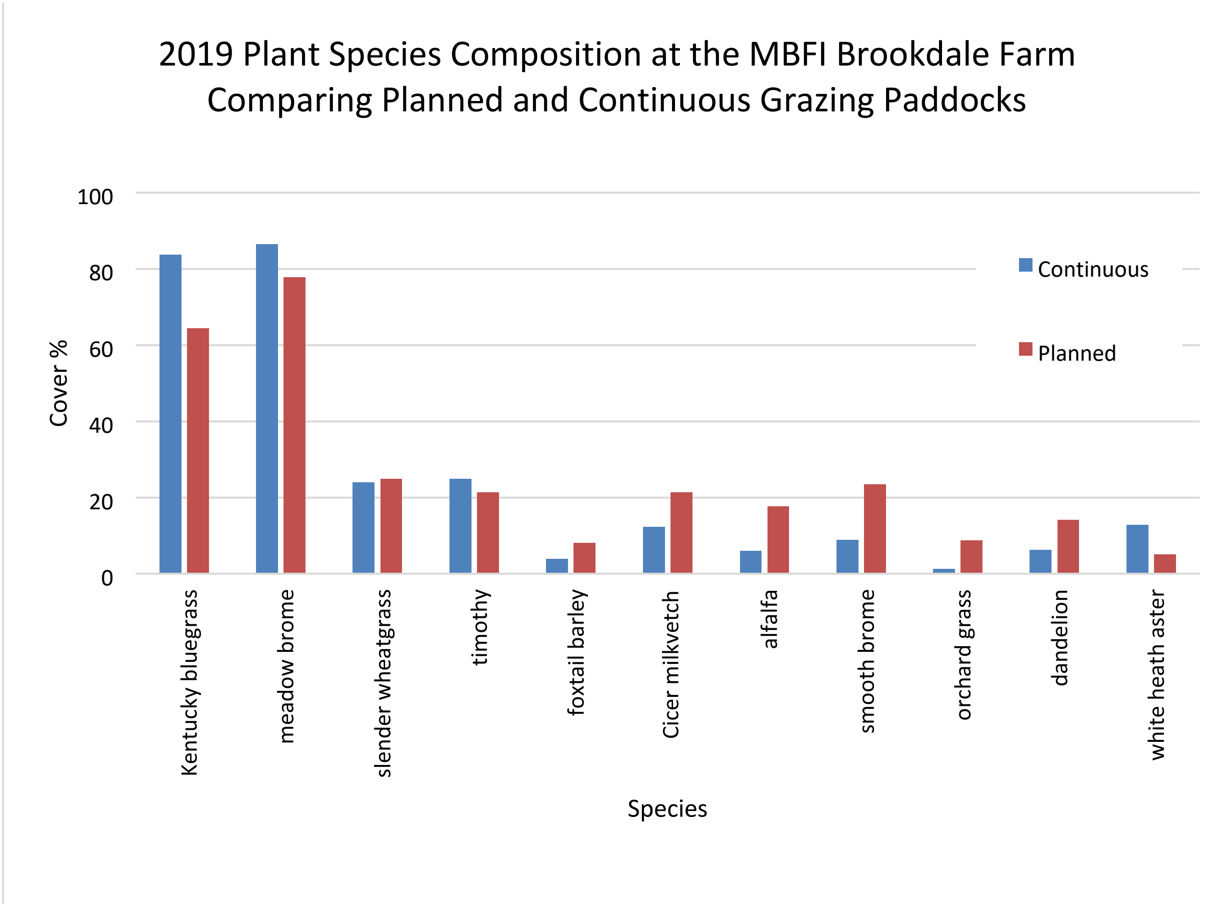

Figure 1.4 2019 Plant Species Composition at the MBFI Brookdale Farm Comparing Planned and Continuous Grazing Paddocks

Economic Analysis

From a winter feed cost perspective this trial showcases the economic benefit very clearly. Since winter feed costs are the highest costs for a producer to keep cattle on their operation, keeping the cows and calves out grazing for a longer period of time, without being a detriment to the pasture longevity and productivity is beneficial for the overall net profit. Average feed costs for producers in Manitoba in the winter of 2019 were estimated to be $2.78 per cow per day (due to the increase in hay prices – hay was valued at $0.75 per pound) plus yardage at $1.61 per day = $4.39 per hd/day. That equated to $4.39 per day X 41 days on pasture. With not having to secure feed and yardage costs for those calves in 2019 = $179.99 X 25 cows = $4499.75 in feed cost savings alone.

From a calf production perspective, the planned calves actually gained 191 pounds and the continuous calves gained 239 from June through to September. However the planned calves did spend additional time on pasture and gained an additional 88 pounds from September through to October. If we calculate the additional 88 pounds at a market price of $2.00 per pound that also equates to a net profit of $176 more in profit X 25 calves = $4400.00. Even though the planned calves only gained 2.5 lbs per day and the continuous calves gained 2.8 lbs per day there was still more to be gained for the additional time on pasture. This included the additional prospective income and savings in the above mentioned feed costs.

The same held true in 2020 where the continuous calves performed somewhat better than the planned calves at 2.3 lbs/day and whereas the planned calves gained 2.2 lbs/day. There was an additional 51 lbs gain however after the continuous herd was taken off trial and 23 additional days grazing.

Average feed costs for producers in Manitoba in the winter of 2020 were estimated to be $2.15 per cow per day (with hay was valued at $0.05 per pound) plus yardage at $1.71 per day = $3.86 per hd/day. That equated to $3.86 per day X 23 days on pasture. With not having to secure feed and yardage costs for those calves in 2020 = $88.78 X 25 cows = $2219.15 in feed cost savings alone. In 2021 they were estimated to be even higher due to dry conditions at $3.57 per cow per day ($0.09 per pound for hay) and yardage at $1.83 = $5.40 per hd/day.

From a calf production perspective, the planned calves actually gained 254 pounds and the continuous calves gained 267 from June through to September. However the planned calves did spend additional time on pasture and gained an additional 51 pounds from September through to October. If we calculate the additional 51 pounds at a market price of $2.00 per pound that also equates to a net profit of $102 more in profit X 25 calves = $2550.00. In 2021 the planned calves had an additional 54 lbs of gain in total at a market price of $2.35 per pound for a net profit of $3,172.50 more in profit as well.

The calves may have gained more in 2019 on the additional days on pasture due to additional moisture later in the fall, and potential forage production increase, whereas in the fall of 2020 precipitation was much more limited as per the precipitation data report as above.

Economic Comparison for Planned over Continuous Grazing at MBFI Brookdale Farm in 2019-2021						
	2019		2020		2021	
	Feed Cost Savings	Calf Sales Profit	Feed Cost Savings	Calf Sales Profit	Feed Cost Savings	Calf Sales Profit
	$4,499.75	$4,00.00	$2,219.15	$2,550.00	$3,375.00	$3,172.50
Total Profit	$8,899.75		$4,769.15		$6,547.50	

Table 1.3 Economic Comparison for Planned over Continuous Grazing at MBFI Brookdale Farm in 2019-2021

The economic summary in Table 1.3 does not encompass any value on the increased production potential on the landscape or any other ecological goods and services.

Project Findings

This trial has been conducted to showcase how improving management will benefit overall net profit for livestock producers as well as contributing to a healthier and more productive forage stand. Many unknown benefits and ecological goods and services are yet to be determined by additional studies including soil health and carbon sequestration and capture that is well known with regards to forages on the landscape. Economically, planned grazing pays in many ways over and above the financial aspects, but realistically economics are the basis of the decision making on the livestock operation. This planned grazing demonstration has showcased value in the additional management and will continue to support a positive change in the modified landscape by human activity. It is imperative that rangelands are treated and valued properly and that regulated grazing is well understood to maintain and improve these landscapes.

Acknowledgements

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Figure 1.4 Grass Plant at readiness (3 leaf stage)
June 26, 2019

Figure 1.5 Fence line contrast on paddock 7B left (planned) and 6B right (continuous)

Figure 1.6 Planned cows on Paddock 18E June 19, 2019

Figure 1.7 Native Species on Planned Grazing paddock 29G Side Oats Grama and Big Bluestem
Photo Credit – MBFI

Figure 1.7 Water troughs that were moved with the planned herd as they moved through the paddocks.

Figure 1.8 A comparison of the A paddocks on July 13, 2021, continuous on the left and planned on the right, just across the fence line.

Figure 1.9 A comparison of the spring growth of Bromegrass on May 13, 2021 in the planned (left) versus continuous paddocks (right)