

The Northland Dairy Development Trust & The Northland Agricultural Research Farm

Summary of Supplement Trial 19/20 Season

Project funders

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Dairying in a Variable Climate Project – NARF

Chris Boom and Kim Robinson (NDDT, AgFirst Northland)

This trial is being run by the Northland Dairy Development Trust (NDDT) in conjunction with the Northland Agricultural Research Farm (NARF). The project is funded by DairyNZ, Ministry of Primary Industries (Sustainable Farming Fund) and Hine Rangi Trust with support from commercial sponsors.

Summary

This is a 3 year farm systems trial investigating the use of palm kernel extract (PKE) and other supplements on farm production and profitability. There are three independent 28ha farmlets :

- **Pasture Only farm**, (2.7 cows/ha) no imported feed
- **PKE Only farm**, (3.1 cows/ha) imports PKE to fill pasture deficits
- **PKE Plus Farm**, (3.1 cows/ha) imports PKE and other supplements to fill pasture deficits.

PKE is fed on the PKE Only and PKE Plus farms only when grazing residuals indicate pasture supply is limiting. Other supplements (DDG and baled silage) are fed on the PKE Plus farm when milk FEI levels indicate no further PKE can be fed without incurring penalties.

Key features of 2019/20 season

- wet Aug/Sept which led to severe feed shortage on Pasture Only Farm and 8% cows culled Sept
- prolonged drought leading to FEI pressure on PKE Only Farm and 55% cows dried off in March

These difficult climatic conditions resulted in lower milk production and lower pasture eaten compared to the previous season.

	Kg MS/ha		Pasture Eaten tDM/ha	
	2018/19	2019/20	2018/19	2019/20
Pasture Only Farm	996	816	12.6	10.9
PKE Only Farm	1,225	1,129	13.2	11.6
PKE Plus Farm	1,300	1,279	12.6	11.4

This also led to higher supplements being imported. Despite this the response rates to supplement were similar to the previous season at around 100gMS/kgDM fed.

	Imported Supplement kgDM/cow		Response kgMS/kgDM fed	
	2018/19	2019/20	2018/19	2019/20
Pasture Only Farm	0	0		
PKE Only Farm	748	978	100	102
PKE Plus Farm	1,046	1,410	94	104

Financial analysis of the farms considers labour and other variable costs. With a milk price of \$6.35/kg MS during the 2018/19 season, farm operating profit (EBIT) was highest on the PKE Only Farm. Despite a higher predicted milk price during 2019/20 (\$7.20/kg MS), profit on all farms was significantly lower than the previous season. This was due to the drought reducing milk production and increasing the supplement usage (on the supplemented farmlets). The PKE Plus farm was the most profitable due to hitting the sweet spot of

a high milk price with unfavourable weather, showing the high cost of having to dry cows off early on the other farms.

Operating Profit	Milk Price \$6.35/kgMS	Milk Price \$7.20/kgMS	Diff between years
\$/ha	2018/19	2019/20	
Pasture Only Farm	\$3,064	\$1,926	- \$1,138
PKE Only Farm	\$3,365	\$2,187	- \$1,178
PKE Plus Farm	\$3,055	\$2,413	- \$642

Marginal Milk Cost

This trial provides the opportunity to calculate the marginal cost of the extra milk produced on the supplemented farms compared with the Pasture Only farm. This shows the additional milk costing \$6.54/kg MS on the PKE Only farm and \$6.27/kg MS on the PKE Plus farm. Further analysis shows for each dollar spent on purchasing PKE on the PKE Only farm, \$0.85 was added to other farm expenses.

Sensitivity

The 2019/20 financial results show that at a \$7.20/kg MS milk price, there was an advantage to putting PKE and other supplements into the farm system. However the Pasture Only farm was the most profitable at a \$6.00 milk price indicating that the PKE farms needed the high milk price to pay for their supplements.

Operating Profit	Milk Price	Milk Price
\$/ha	\$6.00	\$7.20
Pasture Only Farm	\$947	\$1,926
PKE Only Farm	\$832	\$2,187
PKE Plus Farm	\$878	\$2,413

The operating profit per ha is somewhat sensitive to PKE price (figures are at \$7.20/kgMS milk price).

	Pasture Only	PKE Only	PKE Plus
Operating Profit at \$200/t PKE	\$1,926	\$2,611	\$2,879
Operating Profit at \$300/t PKE	\$1,926	\$2,269	\$2,497
Operating Profit at \$400/t PKE	\$1,926	\$1,928	\$2,115

The operating profit per ha is more sensitive to the milk response from feeding supplements. The figures below are calculated on the PKE Only farm. A poor milk response can strip profits very quickly. Poor responses arise from supplement wastage and poor pasture management, particularly when grazing residuals are not monitored well. Simple decision rules should be adhered to for maximum responses.

Response to Supp	\$6.00/kgMS	\$7.20/kgMS
102gMS/kgDM fed	\$832	\$2,187
80gMS/kgDM fed	\$426	\$1,701
60gMS/kgDM fed	\$57	\$1,257

This project has illustrated that although imported supplements can have a role in improving farm production and profit, care needs to be taken that costs are closely monitored and milk responses are maximised through careful pasture management.

Background

This project is a farm systems experiment that compares three different management strategies within a variable climate and the constraints of milk fat evaluation index (FEI). The project is being conducted at the Northland Agricultural Research Farm (NARF), commenced in June 2018 and runs for three years.

Data collected allows examination of the effects of these systems on milk production, farm operating profit, environmental sustainability, cow welfare, labour, and capital requirements. This project will assist farmers in developing more resilient, profitable, and potentially lower impact farming systems.

Farmlet structure

All farms are self-contained farm systems. Each farm is 28 ha with paddocks allocated so pasture growth potential is similar across farms. Silage can be made when there is a pasture surplus and fed when pasture supply below feed demand.

The three farm systems are:

1. Pasture Only – 2.7 cows/ha

A simple pasture only system. Silage is made when pasture surpluses occur and fed back as required.

2. PKE Only – 3.1 cows/ha

PKE is fed when pasture grazing residuals fall below target levels while maintaining ideal grazing rotation length. PKE is not used to create a pasture surplus for conservation. PKE use is constrained by the need to keep the milk fat evaluation index (FEI) within the acceptable limits set by Fonterra.

3. PKE Plus – 3.1 cows/ha

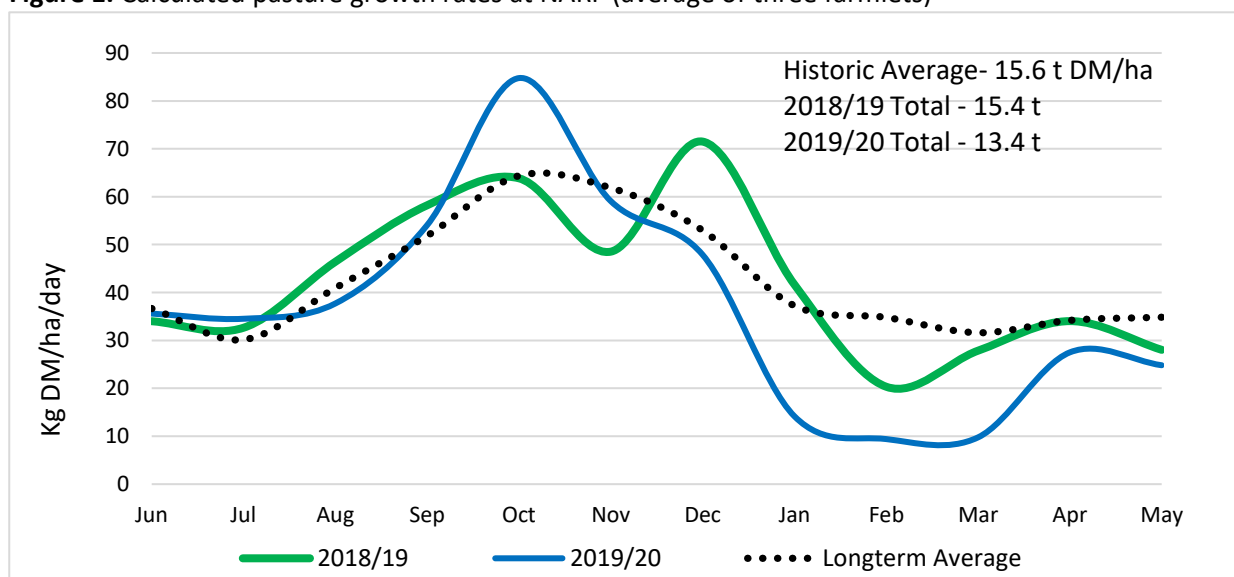
Supplements are fed when pasture grazing residuals fall below target levels. PKE is used first until milk FEI limits are reached and then alternative spot market feed sources are used.

Full Results

Pasture Growth

Pasture growth during the 2018/19 and 2019/20 seasons are shown in the graph below as calculated by post and pre-grazing pasture assessments. The 2019/20 season has been marked by a prolonged drought. Total pasture production during 2019/20 season was 2t DM/ha lower than average. Around 150kgN/ha was used on all three farmlets.

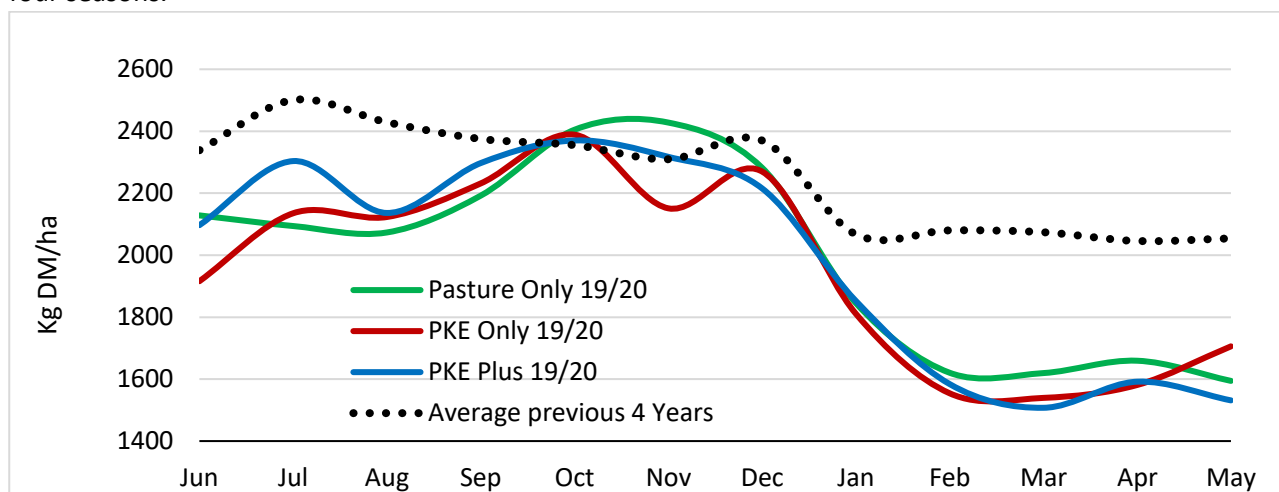
Figure 1. Calculated pasture growth rates at NARF (average of three farmlets)



Pasture Covers

Throughout much of the 2019/20 season, farm pasture cover was lower than the average of the previous four seasons (see Figure 2) with the drought keeping pasture covers around 1600 kg DM/ha from February through to May. For most of the season there was little difference between farms.

Figure 2. Average farm pasture cover for the 2019/20 season compared with the average of the previous four seasons.



Supplement Use

Table 1 shows the supplement fed during the 2019/20 season along with area cut for silage. Good pasture growth conditions allowed all farms to make baleage through late spring, though the Pasture Only farm made twice the amount of the other two farms (due to lower stocking rate). This baleage was very valuable and was mainly fed back onto the farms during summer/autumn.

The PKE feeding level was constrained by milk FEI through much of summer and autumn. During this period, feeding was generally around 3 kg DM PKE/cow/day with slightly more for the PKE Plus herd which was getting other supplements through much of this time. The costs below include delivery charges which were \$23/t for PKE into the bin and \$60/t for DDG into the silo.

Table 1. Supplements fed during 2019/20 season (kg DM/cow), price of supplements landed (¢/kg DM) and % of farm cut for silage.

	Supplement	Kg DM/cow	Cost of Supplement Delivered	Cost of Supplement ¢/kg DM	% of Farm Cut for Silage
Pasture Only Farm	Grass Silage (home-made)	404	\$44/b	14.4	57%
	Total				
PKE Only Farm	Grass Silage (home-made)	181	\$44/b	14.4	28%
	PKE	978	\$324/t	35.4	
Total		1159			
PKE Plus Farm	Grass Silage (home-made)	156	\$44/b	14.4	25%
	PKE	1,093	\$324/t	35.4	
	DDG	210	\$624/t	69.4	
	Grass Silage (purchased)	107	\$90/b	35.0	
Total		1,567			

Stocking Rate Management and Milking Frequency

The farms are governed by decision rules to ensure animal welfare is maintained. If cow condition is low (3.5 or less) and feed is not available then cows are put on once-a-day milking (OAD), dried off or culled to reduce feed demand.

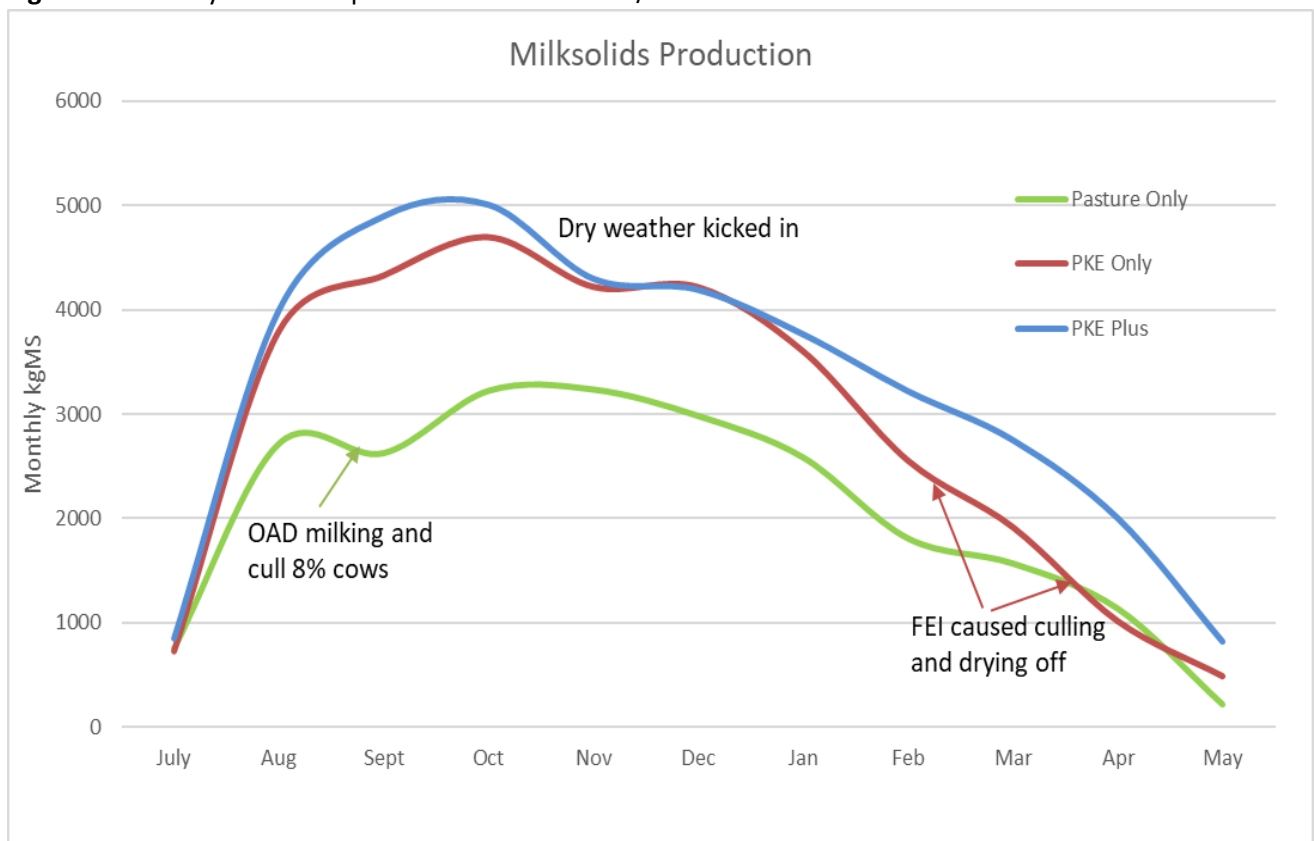
During spring 2019 all cows on the Pasture Only farm were placed on OAD milking for 4 weeks due to low pasture cover and falling cow condition. In comparison only a handful of cows from the PKE Only and PKE Plus farms were placed on OAD.

Low pasture cover and poor pasture utilisation continued on the Pasture Only farm resulting in the need to reduce stocking rate by culling 8% of the herd on 12 September. Empty cows were taken out in late February and then light cows were dried off in late March. Of cows calved, 64% were milked through to early May when all were dried off.

The PKE Only farm encountered high milk FEI in late February so culls were removed. An additional 40% of the herd was dried off in late March due to elevated milk FEI. Only 42% of cows remained milking through to 20th May.

PKE Plus cows had culls taken out in early March and had 78% of calved cows milked through to 20th May.

Figure 3. Monthly milksolids production for the 2019/20 season



Milk Production and Mating

Milk production during 2019/20 was significantly lower than the 2018/19 season for the Pasture Only and PKE Only farms, mainly due to drought and earlier culling and drying-off. The PKE Plus farm dropped slightly compared to the previous season. Despite the difficult spring there was no difference in mating results.

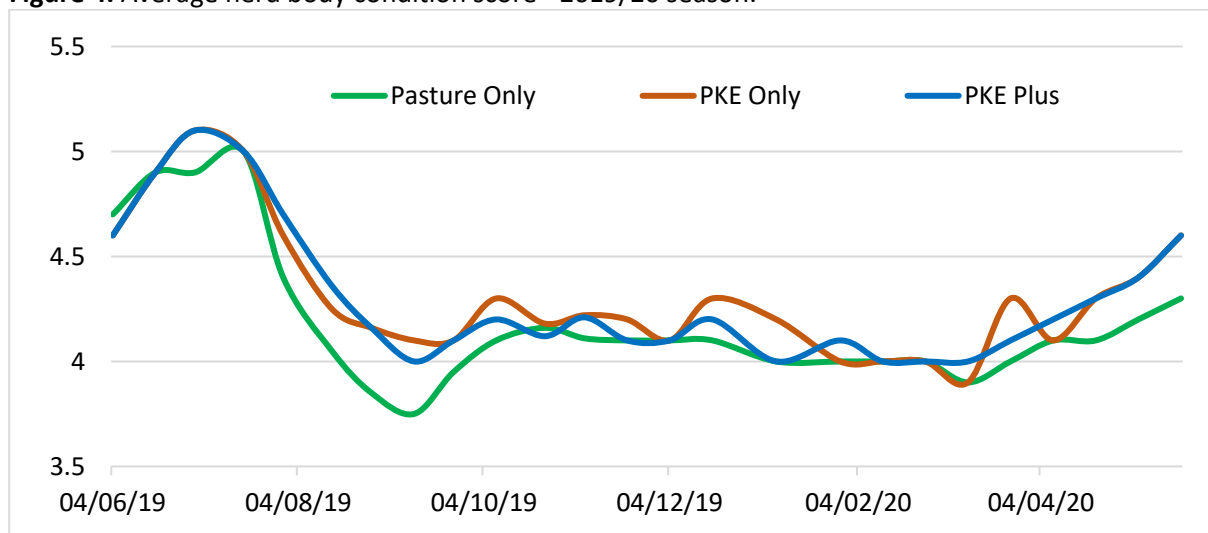
Table 2. Total milk solids production per ha and per cow and empty rate (cows in calf/cows at mating).

	Kg MS/ha		Kg MS/Cow		Empty Rate	
	2018/19	2019/20	2018/19	2019/20	2018/19	2019/20
Pasture Only Farm	996	816	372	313	9%	6%
PKE Only Farm	1,225	1,129	403	359	11%	6%
PKE Plus Farm	1,300	1,279	423	407	6%	7%

Body Condition Score

Body condition score (BSC) is assessed fortnightly. The Pasture Only farm had lower condition score during spring and late autumn than the other farms. Earlier drying-off allowed the Pasture Only cows to regain condition faster during May.

Figure 4. Average herd body condition score - 2019/20 season.



Responses to PKE

Comparing milk production on the two PKE supplemented farms with the Pasture Only farm provides a calculation of milk solids (MS) response to supplement on a whole farm system basis. These supplement response rates are lower than the three previous seasons which averaged 122 g MS/kg DM PKE fed. Overall, response rates on the PKE Plus farm were similar to the PKE Only farm, despite the use of DDG which has higher energy and protein levels than PKE.

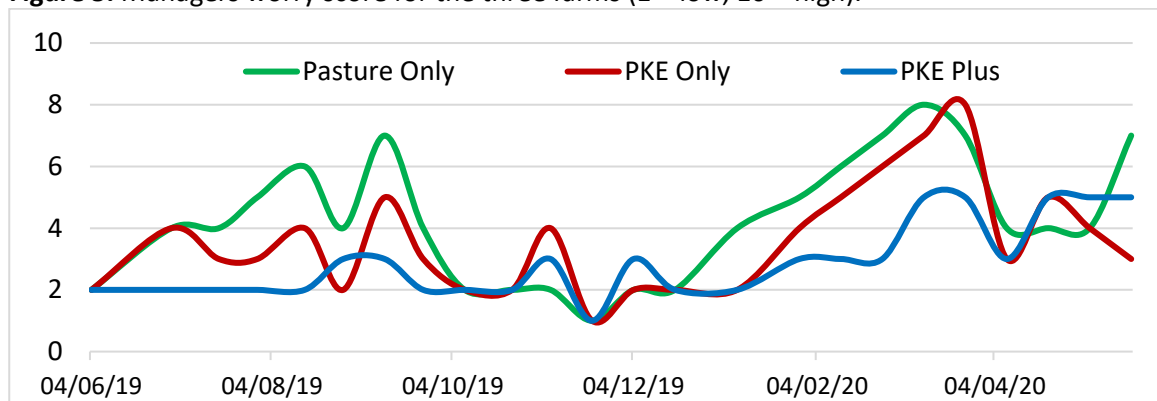
Table 3. Supplement response calculations relative to the Pasture Only farm (g milk solids/kg DM supplement fed).

	PKE Only farm		PKE Plus farm	
	2018/19	2019/20	2018/19	2019/20
Milk Solids Response g/kg DM supplement fed	100	102	94	104

Worry Score

A worry score has been assessed fortnightly. This relates to the concern the manager has about cows and feed supply. The Pasture Only farm had a higher worry score during late winter/spring and summer, largely due to the inability to bring in additional feed. The worry score for the PKE Only farm was also elevated during late summer/early autumn when milk FEI was constraining PKE feeding.

Figure 5. Managers worry score for the three farms (1 = low, 10 = high).



Pasture Eaten

The table below shows the pasture eaten calculation for the 2018/19 and 2019/20 seasons. The effect of the drought can be clearly seen in the large drop in Pasture Eaten across all farms.

Table 4. Calculated pasture eaten (t DM/ha/year)

	2018/19	2019/20
Pasture Only farm	12.6	10.9
PKE Only farm	13.2	11.6
PKE Plus farm	12.6	11.4

Differences in Labour & Machinery

Time spent doing tasks on each individual farm has been calculated, over and above farm operations that are common to all farms. The table below shows the additional time required by NARF staff for feeding out and moving cows to and from the feed pad. These results have been used to adjust the allocation of labour and vehicle expenses within the financial analysis.

Table 5. Additional labour and tractor time for each farm for feeding supplements in the 2019/20 season.

	Additional Tractor Hours	Additional Labour Hours
Pasture Only farm	45	45
PKE Only farm	95	337
PKE Plus farm	123	383

Financial Analysis

The financial results for the three farms have been calculated and are shown in Table 6. A milk price of \$7.20/kg MS has been used for milk income. Expenses are based on actual expenses with some adjustments for labour and administration to compensate for extraordinary expenses involved in running the research farm. Records of additional labour and tractor time for each farm have been used to adjust the vehicle, R&M and depreciation expenses.

For the 2019/20 season, farm working expenses/kg MS were lowest on the Pasture Only farm and highest on the PKE Plus farm. Farm operating profit was highest on the PKE Plus farm, followed by the PKE Only farm. At a milk price of \$6.00/kg MS the Pasture Only Farm would have been slightly more profitable. This is because there were significant cost savings during the OAD milking periods. During the previous season farm operating profit was highest on the PKE Only farm, while being similar on the other two farms with a milk price of \$6.35/kg MS.

Feeding supplements increases farm costs other than just the cost of the supplement itself. On the PKE Only farm, each dollar spent on purchasing PKE had an additional \$0.85 of other farm expenses. For the PKE Plus farm this was \$0.61 on top of each dollar spent on purchasing supplement.

The 2019/20 financial results show that at a \$7.20/kg MS milk price, there was an advantage to putting PKE into the farm system. This was further enhanced when additional supplements were added even though these supplements were at a significantly higher price. This economic return from high priced supplements was largely related to the ability to continue milking most cows through to May.

The cost of the additional milk produced by the supplemented farms can be calculated can be compared to the Pasture Only farm. This cost was \$6.54/kgMS for the PKE Only farm and \$6.27/kgMS PKE Plus farm. This compares to the previous season where the cost of the marginal milk was \$5.39 and \$6.67 for the PKE Only and PKE Plus farms.

Table 6. 2019/20 season income, expenses and operating profit for the three NARF farms.

Financial Summary 2019/20	Pasture Only Farm	PKE Only Farm	PKE Plus Farm
Income	\$/ha	\$/ha	\$/ha
Income from milk (\$7.20/kg MS)	\$5,875	\$8,129	\$9,212
Dividends	\$30	\$30	\$30
Income from stock sales	\$267	\$322	\$322
Total Income	\$6,172	\$8,479	\$9,564
Expenses			
Wages	\$1,082	\$1,648	\$1,699
Animal Health	\$173	\$205	\$205
Breeding Expenses	\$177	\$211	\$211
Shed expenses	\$107	\$123	\$123
Electricity	\$159	\$186	\$186
Grazing	\$442	\$533	\$533
Calf rearing	\$36	\$43	\$43
Silage Making	\$177	\$84	\$79
PKE		\$1,107	\$1,230
DDG			\$458
Purchased Silage			\$116
Nitrogen/Fert	\$369	\$396	\$396
Regrassing	\$121	\$121	\$121
Weed and Pest	\$134	\$134	\$134
Vehicle Expenses	\$158	\$227	\$267
R&M General	\$409	\$440	\$440
R&M Effluent	\$27	\$42	\$42
Administration	\$128	\$133	\$133
Rates and Insurance	\$219	\$227	\$227
Depreciation	\$303	\$435	\$511
Total Operating Expenses	\$4,246	\$6,294	\$7,151

Farm Working Expenses/kg MS	\$4.83	\$5.10	\$5.19
Operating Profit			
Operating Profit at \$7.20/kg MS	\$1,926	\$2,187	\$2,413
Cost of Marginal Milk		\$6.54	\$6.27
Alternative Milk Prices			
Operating Profit at \$4.00/kg MS	-\$685	-\$1,426	-\$1,681
Operating Profit at \$6.00/kg MS	\$947	\$832	\$878
Operating Profit at \$8.00/kg MS	\$2,579	\$3,090	\$3,436
Alternative PKE Prices (delivered wet weight)			
Operating Profit at \$200/t PKE	\$1,926	\$2,611	\$2,879
Operating Profit at \$300/t PKE	\$1,926	\$2,269	\$2,497
Operating Profit at \$400/t PKE	\$1,926	\$1,928	\$2,115

The profitability was somewhat sensitive to change in PKE price this season as shown above. This is because significantly more PKE was fed in response to the drought. (3-3.5tDM/ha compared to 2.3tDM/ha last season)

The profit was also sensitive to the milk response to supplements. A relatively small change in milk response can drop profit by \$500/ha. Good milk responses are driven primarily by minimizing supplement wastage during feeding and efficient pasture management through monitoring of grazing residuals. Both PKE farms follow strict decision rules on feeding supplement only when grazing residuals are below target levels. PKE feeding is adjusted at least every two weeks. Supplements are not fed to support daily production levels.

Table 7. Operating Profit at different milk response rates to PKE (on the PKE Only farm)

Response to supp	\$6.00/kgMS	\$7.20/kgMS
102gMS/kgDM fed	\$832	\$2,187
80gMS/kgDM fed	\$426	\$1,701
60gMS/kgDM fed	\$57	\$1,257

Poor milk responses can quickly strip profits and farmers should focus as much on efficient supplement use through monitoring residuals as minimizing supplement price.

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