Management Strategies for Enhanced Beef Production on Suckler Cow Farms

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Abstract
While around two thirds the Norwegian beef is produced on dairy cow farms, meat production on specialized beef farms has increased in recent years. The specialized beef industry consists of suckler cow herds producing calves, and farm operations that purchase weaned calves for fattening. A linear programming (LP) model of suckler cow herds, selling weaned calves at 200 days, was developed to study the influence of certain management strategies on profitability. The data were derived from the records of 31 suckler cow herds from three Norwegian regions. The feed costs for silage (roughly half of the feed), NH3-treated straw, concentrate and farm and range pastures were calculated and used as model input. In the model pasture could account for as much as half of the annual feed intake with spring calving on small British breeds and 30% with autumn calving on large continental breeds. In region 1 and 2 in south Norway, late harvesting of roughages and using NH3 treated straw was advantageous compared to earlier harvesting and less concentrates. The growth rate of calves was demonstrated to be an important parameter for the economy in both British and continental breeds. Shortening age at first calving to 2 years, and the calving interval to 12 months was profitable but the gains were small. Similarly, the front-end loading concept with 2/3 of the calves after the first ovulation period, and the remaining in the next, was profitable compared to a similar number (1/3) in three subsequent periods. The economics of a high or low replacement rate was also examined.

Key words: suckler cows; management strategies; breeds; agricultural area; NH3-treated straw

Introduction
The beef industry in Norway is investigating ways to improve profitability. The industry consists of suckler cow herds producing calves for fattening on the farm or sale, and a small number of farm operations purchasing weaned calves for fattening indoors. Steers are uncommon, less than one percent. In a sample of 31 herds, silage constituted roughly half of the feed energy, NH3 treated straw 5%, concentrates 8%, and the rest was pasture. Pasture constituted 30.7% of the energy for continental breeds and 44.5 % for the smaller British breeds (Wetlesen, 2020). Most beef farmers have access to farm pasture and many also use outfield rangelands, however pasture intake is limited by the short grazing period (approx. 4 mo.). Late winter calving was reported to be advantageous on alpine or sub-alpine pastures in Switzerland (Estermann et al. 2003) and was practiced by more than 90% of the Norwegian suckler cow farmers (Wetlesen, 2020).

Utilizing heterosis effects by cross breeding and rotational crossings require that the cow has many calves and a long lifetime. However, the cows increase weight in their third year after receiving the first calf at two years of age (Animalia, 2013). By slaughtering cows after two or three calvings, one maximizes cow meat production in proportion to the production on the offspring. Suckler cows should not be slaughtered before the last calf is weaned. In Norwegian data calves from primiparous cows are usually heavier than later born calves, but on the other hand there are more birth difficulties and higher mortality for the first calf (Animalia, 2013). Furthermore, after the calving it takes longer, 80-100 d., before the first calving cows show heat versus 35-70 d. for older cows, increasing the likelihood that subsequent calves will be born late relative to pasture time. In a pure breed herd, the replacement rate can be as low as 0.10 if the cow gets 10 calves and is slaughtered at 11.5 years. If the cows are slaughtered after 2-3 calves the rate can reach 0.50.

The objectives of the study were to investigate and compare management strategies to improve the economy in suckler cow beef production systems under Norwegian conditions.

Method
The analysis dealt with suckler cow herds with calving time in late winter or in the spring and selling six months old (weaned) calves in the fall. For pregnant cows late harvested silage with high fibre content or NH3-treated straw can be used as winter feed. NH3-treated straw must be supported with protein concentrate or earlier harvested silage. NH3 treated straw and pasture were cheaper per energy unit, than baled silage. The feeding value of silage was determined by its digestibility and positively correlated with changes in slaughter weights for beef cattle (Keady et al. 2013). Mating most of the heifers and slaughter those who do not get pregnant early enough, was compared to slaughtering most heifers and keeping suckler cows in production longer. Additionally, the economics of small British breeds with larger continental breeds and the economics

of high and low growth for calves were compared under Norwegian conditions. The following strategies were examined:

1. Using NH3-treated straw with concentrates or early harvested silage as winterfeed.
2. Increasing calf survival, vitality and growth with concentrated calving period (front-end principle).
3. Extensive slaughtering of heifers or young cows after their first calf.
4. Comparing the economics of high and low replacement rates.

The analysis was based on initial calving age being around 2 years which, according to Nelson (2016), is more cost efficient than three years. Reducing calving age, calving interval, and a more concentrated calving period (CCP) can be achieved by targeted synchronization of heat and ovulation, and by improved winter feeding. The CCP or front-end concept mean that at least 60-65% of the calvings should occur following the first ovulation period (21 days). The remaining 35-40% should be in the next period. The rationale for this is that the earliest born calves are less prone to infectious diseases since the environment is less infected. Such calves will be larger than later-born calves at weaning. The economics of the CCP principle was compared to one third of the calvings in each of three subsequent 21 days periods, starting at the same time. It was assumed that the losses of calves up to 180 days can be lowered by 0.5 percentage points and the pasture uptake increased due to better synchronisation of calving time and pasture growth as more animals could be released in time. Additionally, the growth rate of calves also may increase due to lower infection pressure and better vitality.

An LP model, with procedure as explained in Luenberger and Ye (1984), was set up to maximize Gross Margins (GM) of a suckler cow farm selling weaned 6 months old calves. The model was parameterized with economic and production data from 31 farm records from a) Grain areas (12), b) Rural valley and mountainous areas in Eastern and Mid-Norway (10), and c) Northern Norway (9) (Table 1). Average time of calving was stipulated to February 28 in the grain areas and March 21 in the other areas based on length of the grazing season. The cost of the roughages per feeding unit of energy (FEm[1]), both silage and NH3 treated straw, including baling and plastic for preservation, as well as farm and range pastures were calculated based on data from the farms and used as model input.

Table 1. Farm area, yields, area and landscape support, and price of pasture and roughages in the regions.

	Grain areas	Valley and mountain areas	Northern Norway
Meadows and farm pasture, ha	60.9	36.5	56.1
Yields, FEm/ha	4,800	4,220	3,650
Area and landscape support, NOK*/ha	1,390	3,710	3,680
Farm pasture, NOK*/FEm	1.38	1.01	1.14
Range pasture, NOK*/FEm	0.32	0.35	0.85
NH3-treated straw, NOK*/FEm	2.33	2.11	Straw not used
Baled silage, NOK*/FEm	2.49	2.88	2.14

*Norwegian kroner, 1 € = 8.08 NOK

The costs of early harvested silage, NOK 2.76/FEm in the grain areas and 3.29/FEm in valley and mountain areas, were assessed based on Flaten et al. (2015). Early harvesting of meadows raised the costs since yields were lower. It was possible to graze meadow and the costs of such pasture were set to the average of cost silage and farm pasture. The annual feed requirements in FEm (winterfeed in brackets) were 3,727 (2,322) and 3,449 (2,551) for high and low growing British breeds and similarly 4,706 (2,622) and 4,199 (3,164) for continental breeds. The income from the suckler cows were the sum from sale of the calf and discarded cows, depending on replacement rates, and different support and supplementary payments. The fixed costs of the barn were not considered but fences were incorporated in the costs of pastures. The amounts of outfield range pastures were limited due to lack of areas in the grain areas and moderate in Northern Norway due to the short grazing season.

Results

The smaller British breeds were more profitable than the larger continental breeds in all the regions, but the continental breeds competed better in the grain areas (Table 2). Using concentrate feed to supplement farm production of roughages was profitable in all regions, particularly in Northern Norway where it was supplemented both in the pasture and indoor seasons for both breeds. In the other regions concentrate was

[1] Feeding unit milk, 1 FEm=6.9 Mega Joule (MJ) of net energy

supplemented only in the winter for the British breeds. Using NH3-straw was profitable in the grain areas and in the nearby valley and mountain areas. While some concentrate is necessary to supplement straw feeding it is not much and not an argument against using straw. However, it was not profitable to supplement straw with more protein rich early harvested silage instead of concentrates. What drives the use of concentrates in the model is the need for more feed than what can be provided by the own farm area.

The Gross Margins were the highest per cow in the grain areas, mainly due to lower costs. Including the support payments, the farms in Northern Norway had the highest per cow income, mainly due to the higher rates for area and landscape support and partly also the support for animals in the region (Table 2). Although the income per cow was somewhat higher for the continental breeds, they also used more concentrates and the farm area gave space for fewer animals, resulting in a poorer economic result.

Table 2. Costs, revenues, and Gross Margins (Norw. kroner) for British (B) and continental (C) breeds.

	Grain areas		Valley and mountain areas		Northern Norway	
Breed	B	C	B	C	B	C
Suckler cows, No.	84	71	52	44	74	53
Meadows and pasture	467,992	466,967	334,931	335,491	259,203	224,948
NH3-straw	65,222	63,607	38,170	37,593	0	0
Concentrates	74,607	135,064	48,958	86,636	363,914	434,778
Meat and breeding animals	947,190	894,095	605,170	570,263	875,844	698,096
Area support	84,564	84,564	135,189	135,189	206,640	206,640
Support for animals	286,280	286,280	300,280	273,779	300,280	300,280
Gross Margin	552,644	441,028	564,531	465,778	644,649	487,921

A more concentrated period of calving was profitable particularly for continental breeds and in Northern Norway due to better use of pastures and less concentrate in the grazing season (Table 3). For farms with British breeds in the other areas only the lower losses of calves affected the optimal solutions. However, improved growth due to lower infection pressure was not factored in. The number of cows were unchanged or showed a small decrease in the alternatives with the more concentrated front-end calving time.

Table 3. Gross Margins with spread and front-end loaded calving and high and low growth for British and continental breeds. Norwegian kroner. Number of cows in parenthesis.

	Grain areas		Valley and mountain areas		Northern Norway	
British breeds						
Gross Margin spread calving	552,664	(84)	564,531	(52)	644,649	(74)
Gross Margin front-end calving	556,815	(84)	567,132	(52)	661,737	(71)
High growth, Gross Margin	554,461	(79)	569,219	(49)	604,111	(78)
Low growth, Gross Margin	552,114	(89)	543,983	(64)	651,945	(77)
Continental breeds						
Gross Margin spread calving	441,028	(71)	465,778	(44)	487,921	(53)
Gross Margin front-end calving	453,288	(70)	477,344	(44)	529,734	(53)
High growth, Gross Margin	373,222	(53)	399,150	(43)	393,508	(53)
Low growth, Gross Margin	471,409	(76)	483,681	(53)	574,819	(67)

The use of pasture was higher in the alternatives with high calf growth and as this can be difficult to supply it led to smaller herds (Table 3). Pasture intake can increase by grazing the meadows, but this leads to less area for winter feed and fewer animals. Only farms in the grain and in the valley and mountain areas with British breeds had better result with high growth. For continental breeds, there was a significantly higher resource input with high growth, and the higher income per cow was not sufficient to compensate for this.

The proportion of heifer calves varies so in practice the lifespan of the cows will increase. Cows that have had two calves will not receive a young cow supplementary payment but will be 3.5 years old and reach high slaughter weight. As a larger part of the calves will be from primiparous cows, 1/3 (33%) for 3 calves compared to 1/8 (12.5%) for 8 calves the chance of calving difficulties and calf mortality increases and lower the profitability in this system.

Table 4. Gross Margins (Norw. kroner) for suckler cow operations according to number of calvings.

	Grain areas		Valley and mountain areas		Northern Norway	
Breed	B	C	B	C	B	C
Basic, 8 calvings	552,644	441,028	564,531	465,778	644,649	487,921
Alt. 1, 6 calvings	557,652	447,877	572,971	467,059	660,956	501,492
Alt. 2, 4 calvings	567,067	458,217	587,780	458,347	687,356	530,706
Alt.3, 3 calvings	575,666	467,626	600,791	448,538	711,829	564,499

Discussion and Conclusions

Overall, the study showed better economic results with smaller British breeds than the larger continental breeds confirming a study in the UK that small cows were more profitable than larger cows when the feed resources were limited (Roughsedge et al. 2003). On smaller breeds it was also profitable to aim for high growth of calves, on the larger breeds that was questionable as the costs increased more than the extra production value. An important challenge for Norwegian suckler cow farmers is to provide enough good pasture at moderate costs to ensure high calf growth. Feeding with NH3 treated straw seems profitable in the grain areas and nearby valley and mountain areas. Some more concentrate is needed, but relatively little so straw feeding is not a reason for high concentrate use by suckler cows. However, was not profitable to harvest roughage early as an alternative to concentrates. In the model it was not possible to purchase bales of silage this option would likely have led to solutions with less use of concentrates, especially in Northern Norway. An important point is that the profitability of suckler cow production decreases when one exceeds the limit for supplementary payments, in Norway at 50 cows. It is then probably more profitable to fatten more calves than having more cows.

To increase meat production the focus of the management should be on the reproductive ability of the cow such as number of calves born and calf viability and growth. Increasing frequency of twin births, fewer stillborn calves and better calf vitality are obvious factors, but measures to improve them can be difficult to identify. Narrowing and concentration of the calving time is interesting to reduce calf losses and improve growth of the calf since the infection pressure is lowered. There are also work-related benefits and better synchronization of feed requirement for the suckler cow and the calf relative to pasture production. Feeding all heifers calves and slaughter them as young cows instead of heifers or reduction of years in production and the number of calves before slaughter of suckler cows seems profitable due to better utilization of the growth ability of the young cows. However, utilizing heterosis effects requires that the cows have many caves during their lifetime.

Acknowledgements

The authors are grateful to the Research council of Norway and the farmers' cooperative slaughterhouse Nortura for funding the study.

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