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Management strategies to improve environmental and economic outcomes of sheep farms in Norwegian coastal and fjord areas.

2. Effect of ewe size and breed characteristics on rangeland utilisation and sustainable management

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Abstract. Morphological and productive aspects of Norwegian sheep have developed over time and adapted to the diverse environment of the country. To increase weight and reproductive efficiency, native sheep were crossed with UK breeds before 1900. Subsequent selection programs eventually led to the creation of the heavier (adults often > 90 kg) Norwegian White Sheep (NWS), today constituting 70 % of the recorded ewes. The modern Spæl sheep, mostly <75 kg and accounting for 21.5% of the recorded ewe population, originated from the native short-tailed breeds that are smaller and prefer grazing in higher areas. The Norwegian terrain is rugged, but with rich summer pastures in-between, possibly making Spæl a better-suited breed than the NWS, at least in some environments in the coastal and fjord areas. Demand for fresh meat year-round may also favour production changes. Efficient and increased use of local feed resources, and knowledge of ewe size, litter size, growth patterns, and pasture area utilisation, is essential for a changeover to Spæl. Spæl may be more efficient than the NWS in terms of less dependency on concentrates, and better utilisation of local pastures. Smaller adults imply reduced housing demands, and it may also be better suited for being outdoor in the mild winters in the area. In this paper, we compare the farm profitability of the two breeds using a linear programming model worked out for the coastal and fjord areas. The impact of ewe body weight, housing capacity, and meat produced per unit of concentrate are discussed.

Keywords. Ewe size – Grazing – Concentrates – Spæl sheep.

Stratégies de gestion visant à améliorer les résultats environnementaux et économiques des élevages ovins dans les zones côtières et les fjords norvégiens. 2. Effet de la taille des brebis sur l'utilisation des pâturages et la gestion durable

Résumé. Les aspects morphologiques et productifs des moutons norvégiens se sont développés et adaptés à la diversité du pays et aux systèmes d'élevage. Pour augmenter le poids et améliorer les performances de reproduction, les moutons indigènes ont été croisés avec des races britanniques avant 1900. Des programmes de sélection ultérieurs ont finalement abouti à la création d'un mouton blanc plus lourd (adultes > 90 kg), le NWS, qui représente aujourd'hui 70% du cheptel ovin en Norvège. Les moutons 'Spæl' modernes pèsent pour la plupart <75 kg et ne représentent que 21.5% de la population ovine. Ils proviennent des races indigènes à queue courte, qui sont plus petites et préfèrent pâturer dans les zones plus élevées. En Norvège le terrain est accidenté, avec cependant de riches pâturages d'été, faisant de Spæl une race peut être mieux adaptée que la NWS, du moins dans certains milieux des zones côtières et des fjords. La demande de viande fraîche toute l'année peut favoriser quelques changements dans les modes de production. L'utilisation efficiente et accrue des ressources alimentaires locales pour les animaux, ainsi que la connaissance du format des brebis, de la taille de portée, des modèles de croissance et de l'utilisation des pâturages, sont essentielles pour passer à la race Spæl. La Spæl pourrait être plus efficiente que la NWS avec moins de dépendance aux concentrés et une meilleure

utilisation des pâturages locaux. La moindre taille des adultes implique une réduction des besoins de stabulation en hiver et pourrait être mieux adaptée à un hivernage en extérieur pendant les hivers doux de la région. Dans cet article, nous comparons la rentabilité entre exploitations utilisant l'une ou l'autre race, à l'aide d'un modèle de programmation linéaire élaboré pour les zones côtières et les fjords. Les effets de la taille de l'animal, de la capacité de stabulation, et de la production de viande ovine par unité de concentré, sont discutés.

Keywords. *Format des brebis – Pâturage – Concentrés – Race spæl.*

I – Introduction

Due to the long winters, the majority of Norwegian sheep-farmers operate within strict environmental boundaries with in-door feeding from October (autumn) to May (spring). Availability of homegrown feed, mainly grass-silage, is limited due to the short growing season on smaller agriculture farms. During the summer months, on the other hand, high quality pastures and vast rangeland resources are freely available, providing more than 50% of the annual feed consumption of the sheep herds (Asheim & Mysterud 1999; Bhatti *et al.*, 2019b). Farmers are seeking to optimise the number of lambs per ewe to have more lambs ready for slaughter in the fall. Usually, ewes and yearlings can sustain twins and singletons during the grazing period, whilst triplets require the availability of better pastures.

The Norwegian White Sheep (NWS), a composite prolific breed weighing approximately 100 kg when adult and kept for meat and wool, constitutes 70 % of the recorded ewe population. At birth and at the end of the grazing season (October), the number of lambs per ewe is 2.3 and 1.9, respectively, with a final lamb-BW of 43.7 kg (Sauekontrollen, 2018). The higher prolificacy comes at a cost of extra management required for the triplets thereby rearing lambs artificially using milk powder and concentrates in addition to lambing difficulties. In a study with ewes having triplets (Dønne, *et al.*, 2109), 48% of deliveries occurred naturally, while minimum and high levels of assistance were required for 30 and 22% of the lambings, respectively. NWS needs continuous surveillance during lambing. Sheep farming is normally a part time occupation in Norway, and the lambing time puts a heavy load on the care-takers.

The indigenous short-tailed sheep (Spæl) is the second most common breed in Norway and includes 21.5% of the recorded sheep population. There are further five sub-types within Spæl. The White Spæl (9.6%), kept for meat and wool, is the most common Spæl. The average number of lambs per ewe at birth and in September (end of grazing) are 2.1 and 1.8, respectively. BW of lambs in fall is 41.8 kg, and mature BW of ewes (5 years) is approximately 75 kg (Sauekontrollen, 2018).

In the national recording scheme, involving 52.1% of the approximately one million winterfed sheep in the country, the productivity indicators give an advantage to the heavier NWS-Sheep. Though, when calculating lamb production in the fall per 100 kg ewe-BW, the performance of NWS and White– Spæl were 83 and 100 kg, respectively. This shows that Spæl is the most efficient breed for converting roughages and pasture into edible food.

Compared with NWS, anecdotal evidence indicates that Spæl sheep stay together in larger flocks, cover longer distances and use the steeper hill-sides. The Norwegian terrain is rugged with rich summer pastures in-between, making Spæl a better-suited or complementary breed to the NWS. Also, the Spæl ewe would have a longer breeding life. Spæl has more browsing tendency than that of NWS, possibly making this breed more suitable for managing the traditional pastures (Steinheim *et al.*, 2005; Stenheim *et al.*, 2003). Furthermore, recent findings indicate no differences in meat quality between yearlings (mutton) and lamb's meat for Spæl, while significant differences were observed for NWS (Bhatti *et al.*, 2019a). The price difference between lamb meat and mutton is large thus making lamb production much more profitable.

The coastal farmers, due to the milder climate, may graze their sheep in high-mountains during summer, lower-mountains during fall and finally along the fjord during wintertime. Still, such an adaptation is not common. Both inland and coastal farmers routinely sell lambs in September-October, resulting in pressure on slaughtering-facilities and shortage of fresh lamb-meat in the off-season.

In the UK, the "British Lamb" is usually sold fresh to compete with imports of frozen New Zealand lamb. We believe that, in Norwegian coastal areas, well-managed store lambs (in Norwegian called as *Fjorlam*) consuming home grown feeds might offer an opportunity for the farming industry in terms of regular cash flow and support sustained supply of quality meat throughout the year. A well-planned system of store lamb production with extended grazing season coupled with the appropriate concentrate supplementation may improve feed utilisation, profit margins and the environment. Increasing demand for fresh meat year-round may favour the production changes, and such extensive production systems would allow for more lambs to be slaughtered in the period from early winter to autumn.

The objective of this study was to examine the farm profitability of the Norwegian short-tailed Spæl breed (White Spæl) in an extensive system with three alternative practices at the Norwegian coastal and fjord areas.

II – Materials and methods

To compare the economics of rearing Spæl breed (White Spæl) in an extensive system with three alternative practices, we applied a Linear Programming (LP) model as described by Asheim *et al.*, (2014). The model was updated to reflect the price level in 2018 and parameterized with i.a. data from 18 sheep farms in the region (Bhatti *et al.*, 2019). Moreover, we used data assuming the weights and growth rates of the White Spæl for modelling purposes. The daily feeding requirements, including the minimum amounts of concentrates, were lowered by 25% compared to the rates for the NWS breed due to the smaller size of the breed.

In the current practice, we assume : yearlings giving birth at one year, a 3-4 years lifespan of ewes, lambings taking place around April 15 and slaughtering of lambs on September 20, similarly to the NWS breed.

The extensive system includes three alternative practices:

1. Postpone 1st lambing until the onset of grazing (around May 1) and slaughtering around October 5.
2. Overwinter female lambs and market them as yearling lambs in July or August.
3. First-lambing at two years, assuming a breeding-life for ewes of five years.

III – Results and discussion

The profitability was slightly higher for Spæl than for NWS (presented in the first paper). Due to the smaller size of the Spæl, feed intake is lower and more ewes can be maintained during the winter. In addition to the production of more lamb's meat per unit of winter feed, the Norwegian lump sum subsidy payments per animal are favouring less-heavy animals (lamb and sheep). The lump sum subsidy payments are less for the sheep herds with more than 150 sheep-heads while lambs get paid based on certain carcass quality (EUROP). We present the results of modelling the farm-income for a herd of Spæl-Sheep in Table 1.

Table 1. Effects of delayed time of lambing, use of store lambs (Fjorlam), age of first-freshening and ewe's breeding life on farmers' income

	Gross margin	Breeding sheep	Fjor-lambs	Feeding, Concentrate	Roughage FEm*/sheep	Roughage FEm*/ha	Production total Fem*	Hired work, h
Basic, lifetime 3.3 years	423 277	191	0	98	348	2 699	66 354	754
Lambing 16 days later	390 760	193	0	118	326	2 559	62 900	763
Surplus females for Fjorlam	350 828	140	51	75	458	2 611	64 171	583
First lambing at 2 years	365 351	195	0	46	332	2 632	64 687	593
2 years + lifetime 5.3 years	433 421	199	0	65	334	2 703	66 435	718

* 1 FEm = 6.9 MJ net energy.

The results were somewhat similar for the alternative with postponed lambing as for the NWS breed. In alternatives investigated in this study, lambs were supplemented with concentrates due to a shortage of grazing areas in the fall. They would also graze more on arable land which would result in lower production of silage for winter feed. For farmers having more pasture availability in the fall, either the home-near outfield or farm pastures, later lambing may prove more profitable.

In our modelling, we assume the same daily work input per sheep irrespective of breed. The Spæl requires less work per kg of meat produced. Spæl also maintains the "lamb's meat characteristic" even for overwintered store lambs thereby making it a more suitable breed for an extended fresh-meat season (Bhatti *et al.*, 2019a).

Given the huge price differences between mutton and lambs' meat, the offtake of sheep meat needs to be as low as possible. Longer breeding life is possible, particularly for farmers having Spæl.

IV – Conclusions

Until today, the focus of the Norwegian sheep industry has been on the production of lamb's meat and wool from the synthetic NWS-breed. Increased use of the Norwegian short tailed Spæl or similar breeds either as a supplement, or an alternative parallel breed to the NWS might be a way forward particularly in the coastal and fjord areas of the country. We suggest overwintering of Spæl ewe lambs for maintaining open landscapes and biodiversity. To make this happen, we recommend changes in the subsidy scheme in favour of store lamb production. Also, whenever possible, the breeding life of ewes should be prolonged to increase the offtake of lamb's meat and keep the cost of rearing at a minimum.

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