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The implementation of some regenerative practices to improve the sustainability of latxa dairy sheep system

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Abstract. Land use and grazing management practices have changed during the last decades as a result of intensification. Some of the consequences are directly related to environmental impacts. Under this scenario, the assessment of the effect of different management practices is critical to improve the sustainability of land-based systems. The main objective of the current work was to determine the effect of some regenerative practices on productive and environmental parameters. Two essays were carried out with the experimental flock of Neiker during 2014 and 2015, with two grazing regimes: regenerative (RG) and free (FG). Soil, pasture and livestock samples and data were obtained during springs, and carbon footprint was estimated with data collected monthly before (2013) and after (2014-2015) the regenerative practices were implemented. According to the results, there were no differences on milk parameters (daily milk yield and composition) and livestock parameters (live weight and body condition score) due to grazing management. RG regime resulted in 8% higher amount of particulate organic matter in the soil and 10% greater amounts of harvested herbage. Moreover, the regenerative practices implemented reduced the carbon footprint in 10%. As conclusion, the regenerative practices implemented in the study seemed to be linked with an increase of harvested herbage and a reduction of carbon footprint without compromising livestock productive parameters.

Keywords. Grazing management – Latxa dairy sheep – Regenerative practices – Sustainability.

La mise en place de certaines pratiques régénératives pour améliorer la durabilité du système d’élevage d’ovins laitiers Latxa

Résumé. *L’utilisation des sols et les pratiques de gestion du pâturage ont changé au cours des dernières décennies en raison de l’intensification productive. Quelques conséquences sont directement liées aux impacts environnementaux, comme l’empreinte du carbone. L’évaluation de l’effet de différentes pratiques de management est essentielle pour améliorer la durabilité de ces systèmes. L’objectif principal de ce travail était de déterminer l’effet de certaines pratiques régénératives dans les variables de production et environnementale des brebis laitières. Les essaies pour déterminer l’effet sur les variables de production ont été réalisés au troupeau expérimental de Neiker en 2014 et 2015, avec deux régimes de pâturage: régénératif (RG) et libre (FG). Des données et des échantillons du sol, pâture et brebis ont été prélevés aux printemps. D’autre part, l’empreinte carbone a été estimée avec des données recueillies mensuellement avant (2013) et après (2014-2015), la mise en œuvre des pratiques régénératives dans le troupeau. Selon les résultats, il n’y avait pas de différences dans la production quotidienne du lait, mais le régime R a présenté 8% plus de matière organique particulaire organique et produit une récolte de 10% de plus de fourrage. De plus, les pratiques régénératives ont réduit de 10% l’empreinte du carbone. En conclusion, les pratiques régénératives mises en œuvre dans l’étude semblent liées à une augmentation de la production de fourrage et à une réduction de l’empreinte du carbone sans compromettre les paramètres productifs du troupeau.*

Mots-clés. *Gestion du pâturage – Ovins laitiers latxa – Pratiques régénératives – Durabilité.*

I – Introduction

The sustainability of sheep farming systems depends on a diversity of factors related to the technical viability, economic profitability, environmental impact and social acceptance. Land use and grazing management practices, for example, have changed during the past few decades due to the intensification of many flocks. Some of the consequences of these changes are directly related to environmental impacts. Under these circumstances, it is crucial to design grazing management practices suitable to cope with the existing challenges (Ruiz *et al*., 2009).

Despite permanent pastures have a huge capacity for soil regeneration and carbon fixation (Teague *et al*., 2011), little attention has been devoted to grazing practices, and the beneficial impact on soil has been disregarded. In this line, soil carbon plays a vital role to provide essential ecosystem services, such as soil fertility, climate change regulation, water supplies, biodiversity, etc. Therefore, many farmers require knowledge transfer and advisory to improve the utilisation of grasslands and forage resources, when improving the fertility of soils.

Dairy sheep production from pasture in the Basque Country has been traditionally based on the Latxa breed. LIFE REGEN FARMING (*www.regenfarming.com*) tries to innovate grazing management practices to enhance the potential of grasslands to fix carbon and improve pastures' fertility, productivity and, finally, livestock sustainability. The assessment of the effect of these management practices is critical to improve the efficiency of these land-based systems.

The main objective of the current paper was to determine the effect of two different grazing management regimes on pasture and on dairy sheep production variables during the spring lactation period. Soil, pasture, livestock parameters and carbon footprint were monitored in order to determine the effectiveness and the sustainability of these management practices.

II – Material and methods

Two assays (one per year) were conducted with the experimental flock of NEIKER-Tecnalia during spring lactation period (early April – late June) of 2014 and 2015 to assess the effect of the grazing regime on soil, pasture, livestock parameters and carbon footprint. Sheep were blocked into two homogeneous groups of 60-65 ewes, and randomly assigned to two different grazing regimes: free grazing (FG) or regenerative grazing (RG), under the same annual stocking rate (11 ewes/ha). During the assays the size of the paddocks was 7500 m^2 for FG and the same size divided in 8 plots for RG. Each group accessed for 4-9 hours, April-June respectively, to a similar and botanically seminatural pasture after morning milking. Ewes' diet was complemented indoor with a concentrate and fescue hay.

Grazing data were collected daily on grazing-cards to describe the number of sheep per paddock, time spent at the pasture and the grazing management regime. As a summary of the assays, the RG group of ewes grazed 3 times per each plot during 1-3 days/plot each time depending on pasture offer, milk production and climate. As consequence, each plot had a 24±2 days resting time between grazing periods. The FG group of ewes grazed 4 times each plot during 6-10 days/plot each time with a resting period of 15±3 days between grazing periods.

Data and sample collection started after 2 weeks of treatment adaptation. Referring to soil/pasture, the following measurements were made fortnightly:

– Soil samples (n=9) (10 cm depth) were collected in spring 2014-2015 and were submitted to the laboratory to determine some chemical parameters and particulate organic matter (POM) was estimated in 2015. This latter comprises all soil organic matter particles between 0.053-2mm size (Cambardella and Elliot, 1992), is very unstable and easily decomposable.

– "Grazing herbage mass" (GHM): was estimated by cutting herbage to ground level with scissors in a 0.5 x 0.5 m quadrat per paddock and fortnightly during spring 2014-2015. Herbage samples were dried (60ºC / 48h) and weighed. Biomass data were extrapolated to kg DM/ha/year.
– Grass nutritive composition: GHM dried samples were submitted to the laboratory to determine crude protein (CP), acid-detergent fibre (ADF) and neutral-detergent fibre (NDF) contents.
– "Harvested herbage mass" (HHM, kg DM/ha): the surplus of grass was harvested once during the study period (May 2014-2015) due to the excess of pasture production and HHM was estimated by weighting the bales of hay obtained in each grazing regime paddocks.

Referring to livestock, the following measurements were made:

– Daily milk yield (DMY) per ewe was measured during 3 consecutive days, fortnightly. Daily milk yield was corrected to standard DMY as described by Bocquier and Caja (1993).
– Milk composition: individual milk samples were taken at the same days for analyses of crude fat (CF) and crude protein (CP) content.
– Individual live weight (LW) and body condition score (BCS) as described by Wright and Russel (1984) was determined fortnightly.

Finally, carbon footprint was estimated with the methodology described by Batalla et al. (2015), considering the Intergovernmental Panel on Climate Change (IPCC, 2006) and Carbon Calculator (Bochu *et al*., 2013) tool. Regenerative practices applied during the study period were: an increase of 7% in grazing time, removal of the use of chemical fertilizations, and a reduction of 4% of concentrates for feeding.

Pasture and livestock data were analysed by a generalised linear model (SAS, 2010) considering the following fixed effects: grazing management regime (FG and RG), month (April-June) and their interaction.

III – Results and discussion

The average POM values were 28.0±5.30 and 25.7±1.75 for RG and FG, respectively (Table 1). There was higher POM value in the RG regime, which could be due to the higher resting time of this grazing management which allows soil time to recover and fix carbon as POM. Statistic was not applied due to the low number of samples.

Referring to pasture parameters, there were no significant differences on the average GHM ($P>0.05$) and its nutritive value ($P>0.05$) due to the grazing regime (Table 1). Instead, there were significant differences on GHM due to the week of monitoring, with higher values in April and lower in June ($P=0.01$). The nutritive quality of pasture had the same tendency, with no significant differences ($P>0.05$) on CP and fibres due to the grazing management (see Table 1), and with significant differences due to the week of monitoring. The CP also had higher values ($P<0.01$) during April and mid-May, compared to June, whereas fibres had significantly lower values ($P<0.01$ for ADF, and $P<0.001$ for NDF) at the beginning of the spring compared to the end of the spring.

Referring to HHM, average (2014 and 2015) harvested biomasses were 4890±252.4 kg DM/ha and 4387±460.3 kg DM/ha for RG and FG regimes, respectively. Statistic was not applied due to the low number of samples, but results showed higher HHM for the RG (Table 1). The increase in grass surplus in the RG regime could be due to the higher resting time of the paddocks. This harvested grass could save or reduce the purchase of conserved forage under this grazing regime, and improve the feeding autonomy of farms.

In relation to animal parameters, daily milk yield, standardized daily milk yield and milk fat and protein content were similar (P>0.05) for FG and RG groups (Table 1). Finally, ewes of both groups had similar (P>0.05) LW and BCS. There was a significant reduction in DMY and DMYs, and a significant increase in milk CF content between April and June.

Finally, carbon footprint of latxa dairy sheep production ranged between 2.91 and 3.23±0.419 kg CO_2eq/ kg milk (standardized by CF and CP contents). Moreover, comparing the carbon footprint before (2013) and after the regenerative practices were implemented (2014-2015), these practices reduced by 10% the carbon footprint of milk production activity.

Table 1. Effect of the treatment "grazing regime" (free-FG and regenerative-RG) on pasture and livestock parameters: CP-crude protein of grass, ADF-acid detergent fibre, NDF - neutro detergent fibre, DMY - daily milk yield, DMYs-standarized daily milk yield, CF - crude fat of milk, CP* - crude protein of milk, LW - liveweight, BCS - body condition score

	Variables/ treatment	RG	FG	P value
Soil parameter	POM	28.0 ± 5.30	25.7 ± 1.75	–
Pasture parameters	GHM, kg DM ha^{-1}	1590 ± 234	1591 ± 207	0.99
	CP, g kg DM^{-1}	160 ± 36	161 ± 25	0.26
	ADF, g kg DM^{-1}	250 ± 30	251 ± 30	0.73
	NDF, g kg DM^{-1}	500 ± 90	486 ± 60	0.85
	HHM	4890 ± 252.4	4387 ± 460.3	–
Animal parameters	DMY (mL d^{-1})	1510 ± 420	1533 ± 453	0.99
	DMYs (mL d^{-1})	1320 ± 351	1357 ± 382	0.39
	CF (%)	6.63 ± 0.9	6.50 ± 1.0	0.12
	CP* (%)	4.91 ± 0.7	5.04 ± 0.7	0.39
	LW (kg)	60.0 ± 7.6	59.5 ± 8.8	0.19
	BCS	2.50 ± 0.08	2.37 ± 0.08	0.24
Full system	Carbon footprint (kg CO_2eq/ kg milk)	3.23	2.91	–

IV – Conclusions

In conclusion, the regenerative practices implemented in the study seemed to be linked with an increase in surplus herbage for conservation, and with a reduction of carbon footprint, without compromising livestock productive parameters. These results show that there are opportunities for the sheep farming systems to face the existing challenges and to improve the sustainability of the sector through the introduction of regenerative practices in the management of grazing resources.

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