Herbage allowance a management tool for re-design livestock grazing systems: four cases of studies

Geronimo Cardozo [*1], Martin Jaurena [2] & Martin Do Carmo [±2]

[1] Trenta y Tres Experimental Station, National Institute of Agricultural Research (INIA), Uruguay
[2] TacuarembóExperimental Station, National Institute of Agricultural Research (INIA), Uruguay

[*] Speaker

[±] Corresponding author: martindocarmocorujo@gmail.com

1 Introduction

Native grasslands represent the largest agro-ecosystem in the Campos biome region, and provide valuable economic and ecosystem services, but they are critically threatened by changes in land use (Overbeck *et al.* 2007). Animal production limitations in these ecosystems are mainly related to grazing management and its interaction with climatic variability. Low income and degradation of natural grassland by over stocking rate is the major problem of the livestock farmers in Uruguay. Traditional management is not quantitative and over or under stocking, has limited both pasture and animal production. Under experimental conditions, management of herbage allowance (HA) has proved to be an effective tool to increase animal performance without increase in cost of production. Stocking rate is a poor indicator of grazing intensity, in contrast to HA, because it gives no information of feed availability. Herbage allowance measured as kg of forage dry matter (DM) per kg of animal live weight (LW) integrates both animal demand and feed availability (Sollenberger *et al.,* 2005). For Campos grasslands, with the management of herbage allowance it is possible to control herbage growth, individual and per ha animal productivity (Do Carmo *et al.,* 2013; Soca *et al.,* 2013; Nabinger *et al.,* 2000). At farm level the use of HA to manage the grazing pressure in each paddock should improve both animal and pasture production. Optimization of stocking rate to maximize animal production should combine pasture resources and animal demand of each type for each season. The objective of this work was to test HA control on 4 commercial grazing systems evaluating the impact on animal production by changing stocking rate management in time and space. To implement the changes in each farm, we working with a participatory approach that considers the particularities of each producer, co-innovation approach (Dogliotti *et al.*, 2014).

2 Materials and Methods

The study was conducted in 4 farms in Uruguay, each one in a different region (Farm 1: 31º38’53’’ S 56º31’10’’ W, Farm 2: 32º35’46’’ S 56º07’10’’ W Farm 3: 32º38’47’’ S 54º42’38’’ W, Farm 4: 33º42’42’’ S 55º26’46’’ W) from November 2012 to current days. The sizes of these farms are between 465 to 2200 ha and the proportion of improved grasslands is less than 5%, the native grassland is the main feed resource. Three of them combine cattle and sheep mixed grazing. Farm 1 is an open system that has cow-calf system and sale fattened steers but part of them was bought out of the system, also sale cows and growing steers. Farm 2, is a closed system that sale fattened steers but does not bought out of the system, thus has all the sub systems inside the farm. Farm 3, has a cow-calf systems and also sale `pastoral services` to livestock owners. Farm 4, has all systems combined with a strong commercial approach looking for the buy and sell price difference in livestock to make the best price difference, this strategy difficult our main `technical` approach to be implemented. In each farm, we identified the area of technical problem, and with the constraints of each farmer we worked together to try to solve them. The main problems detected were: low herbage production in Farm 1, low general stocking rate in Farm 2, low cow-calf productivity in Farm 3 and relatively low animal production ha^{-1} in Farm 4. Adjustment of herbage allowance was a major target to solve these problems, and do that monthly was the center of the work due to the high environment variability (Wheeler *et al.,* 1973) in Campos grassland. Due to different farms sizes we controlled closely only part of the systems, from 18% in farm 2 to 50% in farm 1, but working with the most demanding process, like fattening and cow`s pregnancy. Herbage mass was measured by "comparative yield method" (Haydock & Shaw, 1975) and stocking rate by monthly or seasonal weight of animals, both used to reach our HA reference value for each season and animal category. Uruguayan rainfall average is around 1200 mm y^{-1} distributed equally around the year, but with high variability between years. The rainfall was above the average in 2012 and 2014 when rainfall average was 1466 and 1800 respectively; in 2013 was an average year, but spring and summer rainfalls were above the average. Animal performance was measured as pregnancy rate and calf weight at weaning for cow-calf systems and meat production ha^{-1} for growing and fattening systems.

3 Discussion

Farm 1, changed the spatio-temporal management of cows and fattening steers, by changing paddocks assigned to each one in each season and by management of seasonal HA, this system implies that during the grassland growing season the fattening steers are in the best paddocks for this season at HA of 6 kg DM kg LW^{-1}or more and growing steers and

cows assigned to other paddocks. However lactating cows are also with 5 kg DM kg LW^{-1} and suckling restriction (Quintans *et al.,* 2010) was applied to enhance pregnancy probability. In winter season when the herbage growth is minimum pregnant cows (at HA of 3,0 kg DM kg LW^{-1}) were allocated to the best paddock of the previous growing season that accumulated herbage during the fattening period. Although the spring-summer rainfall was above the average in the last three years, we measured an increment of the animal production from 90 to 110 kg ha^{-1}, and from 110 to 120 kg ha^{-1} comparing year 2012/13 with 2013/14 and 2014/15.
Farm 2, changed both spatio-temporal use of paddocks and HA by cows and fattening steers to enhance the resource use efficiency. This process involved "cultural" change because by tradition some paddocks were paired to animal category, e.g. paddocks for cows and paddock for fattening all around the year. At these paddocks the stocking rate was increased based on herbage mass measurements, relative to the "traditional management" of the farmer. Live weight production ha^{-1} increased from 111 to 196 kg ha^{-1}, without reducing individual animal performance. HA was managed between 3 to 5 in spring to 7 or 8 in winter, and taking into account the herbage mass also to define HA value due to its influence on herbage intake (Wales *et al.,* 1999). However because general stocking rate of the farm was not increased immediately, net income was not increased, and live weight gain per animal was already high, nevertheless 800 ha from the 2200 ha of the farm were remained ungrazed in the last summer, showing the potential to increase general stocking rate without increase in economic risk or food outside the farm, with a close control of HA only in 18% of the farm.
In Farm 3, initially the stocking rate was relatively high to the herbage mass present, (HA was 4.5 kg DM kg LW^{-1} with herbage mass of 950 kg DM ha^{-1}) and we cannot diminish due to financial constraints. Changing the spatial allocation of the most (lactating cows) and less (cows non-pregnant non-lactating, growing females, recently pregnant cows) food demanding animals we modified the HA for lactating cows during the first breeding season (reaching HA of 6.2 kg DM kg LW^{-1}) and also we added suckling restriction to increase pregnancy probability (Quintans *et al.,* 2010). Compared with the previous years pregnancy rate increased from an average of 70% during 2012 to 88% and 90% for year 2013 and 2014, and calf weight measured in May 2013 was 155 kg and 188 kg in May 2014. Comparing pregnancy rate with the average of the farmers of his region, that report pregnancy rate by themselves, the increment was 7% and 18% for 2013 and 2014 respectively.
In Farm 4, the management focus were the growing steers, similar to Farm 2, however the commercial strategy of the farm, and the constraint to management of livestock, limit the potential increase, anyway HA was adjusted in late autumn to 6.0 kg DM kg LW^{-1} and was 4.4 kg DM kg LW^{-1} in average along the year. Live weight production was increased 20% from 100 to 120 kg ha^{-1} for 2013/14.

4 Conclusions

Along two years of the project, in most cases, HA use has been widespread from paddocks to almost of the systems. The improvement of reproductive and productive results showed how this tool could be useful to sustainably systems re-design, as long as the manager (or farmer) incorporates the tool in his decisions. This tool and the approach (co-innovation) to work with farmers contributed to assess the impact of herbage allowance to adjustments on stocking rate. The increase of livestock productivity was based on native grasslands without additional needs of inputs, specifically by managing the plant-animal interactions at different spatio-temporal levels. Nevertheless, we should confirm these results in different climatic years, and we need to develop predictive tools to reduce the too time-consuming herbage mass measurements in order to simplify the incorporation of HA management technologies in farms.

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