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Meal Plate Index: A simple and robust tool for decision making

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Abstract

Cattle and sheep production in Uruguay is mainly based on natural grasslands. Research has shown that most of the country is overgrazed, so it is important to work with higher grass allowances. A simple, robust tool has been developed that livestock producers can use to budget for feed, called the Meal Plate Index. It is based on the fact that each category of cattle requires a certain amount of forage according to the season and the cattle performance objectives to be achieved - these values have been determined by national research - and is compared with the availability of existing forage, which is estimated using a centimeter ruler - developed in an extension project - that relates grass height to dry matter content per unit height and animal performance. The two factors, the amount of grass available and the need for forage supply, are relate, and according to the result of the index, if the result is between 0 and 0.6, we are in a red zone, in danger and urgent decisions are needed; between 0.6 and 0.8, yellow zone of caution and possible short term decisions; 0.8 to 1.2, green zone, with no immediate need for management changes, and values above 1.2, brown zone, which can only be reached in spring and summer, and due to the fact that most species are C4, this surplus is of very poor quality. Several field days and courses have shown that the index is easy to understand, while its application is strongly conditioned by the fact that the grass should be measured at least every season. Any technology or method that facilitates the measurement or estimation of forage availability will facilitate the use of the index and result in better livestock performance.

Introduction

The lack of timely decisions on pasture supply, affected by climate variability, has a significant impact on the productive and economic outcomes of livestock systems. In Uruguay extensive livestock production based on natural pastures faces frequent droughts, that affect both production and the sustainability of livestock enterprises and their families.

Animal stocking, measured in livestock units (LSU), is used to calculate stress based on the surface area, but does not consider the actual availability of pasture at any given time, which limits its effectiveness. Studies such as that by Do Carmo et al. (2019) show that controlling feed supply improves results, but adoption is low, highlighting the need to involve livestock farmers in decision-making and monitoring.

The objective of this work is to promote the sustainable development of pastoral livestock farming in Uruguay through simple methodologies that facilitate technical change and co-innovation. To this end, an approach is proposed based on monitoring of pasture and animals, pasture diagnosis based on supply, evidence-based discussion and facilitation of adaptive decisions is proposed.

These elements seek to overcome the limitations of livestock systems, which are characterized by their complexity, combining biological components and family contexts, which makes efficient pasture management difficult in an uncertain and variable environment.

In particular, the aim was to develop a simple tool that covers all aspects of feed planning and can be implemented quickly and easily.

Methods

This work was based on the experience that led to the development of the Meal Plate Index (IsPC), Duarte et al 2023.

A total of 35 producers participated in this work, with a predominance of cattle farming systems and a wide variability in land area and resource provision. Initial workshops were held to level knowledge and develop a monitoring protocol. The variables monitored were, for pastures, height measured with a ruler and calculation of availability in kg dry matter (DM) and, for animals, weight measured with a scale and definition of grass requirements according to category. The IsPC, which relates grass supply to demand, was calculated using color-coded ranges: Red (<0.6:) Danger deficit), yellow (0.6-0.8): Caution, Green (0.8-1.2): Optimal, and brown (>1.2): Excess.

The strategies and analysis included the IsPC evaluation carried out in seasonal workshops with technicians and producers, the management strategies with UML diagrams that facilitated the interpretation and prioritization of measures such as sale of animals, deferral of feed, supplementation, etc. The scaling included the field days carried out with technicians and producers.

Dissemination included producer-led field days, on-farm support to new groups, training through workshops and courses, dissemination through articles, seminars and agreements, and the inclusion of the IsPC in national programs.

This methodological approach allowed us to analyze the heterogeneity between farms and to develop a scalable monitoring system that combines technical indicators with participatory strategies.

The methodological-technical framework used in the project was structured around three main pillars: estimation of feed availability, evaluation of animal needs and adjustment of the "diet plate" by calculating the IsPC. Each of these components is described in detail below: Estimation of forage availability:

- Measuring grass height with a ruler in different pastures.
- Convert of these measurements to kilograms of dry matter available per hectare.

Calculate of animal requirements:

- Evaluation of animal weight with a scale.
- Classification according to production category (breeding, rearing, finishing).
- Determine grass requirements based on these categories and production targets.

Adjustment of the "meal plate" (IsPC):

- The relationship between total grass availability and total system requirements.
- Classification according to diagnostic ranges (red, yellow, green, brown).
- Identification and prioritization of management action through participatory workshops.

This approach allowed for comprehensive management of feed and animals, providing producers with a clear diagnosis of the situation on their farm and the IsPC with a practical tool to optimize production based on forage available resources.

To estimate the amount of forage available, the use of a ruler was developed, calibrated and recorded (figure 1).

There is a relationship between the height of the mat and the amount of grass available. This relationship is established or calibrated by seasonal cutting. To do this, at least 30 seasonal cuts are made, looking for variability in height, where the height is measured beforehand and then varies by agro-ecological area and by season, as the structure of the mat changes.

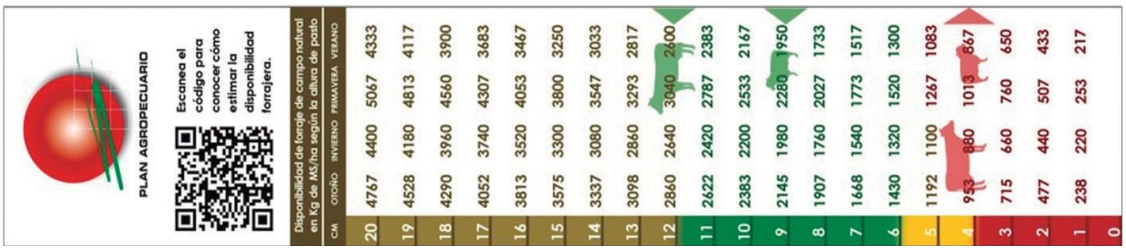

Figure 1.- Ruler developed to estimate forage available

A basic thing to know before taking measurements is the grazing area. Measurements must be taken where the cattle graze, i.e. in the grazing layer, and avoid measuring things that are not part of the diet, such as bushes and shrubs. Pastures have what is known as plant heterogeneity, i.e. different plant communities. Measurements must be made in proportion to the size of each of these. Measurements are taken at the height of the densest layer, i.e. where the highest proportion of forage is concentrated.

It is defined as the kilograms of forage dry matter (DM) per kilogram of cow liveweight (LW) (kg DM/kg LW) and can be calculated for any pasture if we know how much forage there is per hectare and if we know the stocking rate in kg liveweight per hectare.

Forage supply = kg DM forage/kg live weight

Previous experiments carried out at the Faculty of Agronomy have led to the establishment of values of forage supply required by breeding cows in each season, while the rearing data have been constructed based on the results of experiments carried out at UFRGS (Brazil). The suggested values are related to the productive expectations of each category in each season of the year.

Table 1.- Forage supply values for different categories of cattle in different seasons of the year (Do Carmo et al, 2019).

	Offer kg dry matter/kg live weight			
Animal category	Spring	Summer	Autumn	Winter
Rearing up to 300kg	1 - 2	2 - 3	2 - 3	2 - 3
Finishing +300 kg	4 - 6	4 - 6	4 - 6	8 - 10
Breeding cows	More than 6	More than 6	More than 6	3 - 6

In this way, knowing the number of animals in each category, their weight and the amount of forage required (Table 1), it is very easy to calculate the amount of grass required per category and, by adding all the categories, the amount of grass that should be present on the whole farm at the time of monitoring.

The IsPC is calculated by dividing the measured grass by the required grass (kg DM grass / kg DM required):

IsPC = measured grass/required grass and i.e. the result obtained is 0.96, it means that the meal plate is 96% full.

Results

In this work, grass height has a high positive correlation with IsPC (figure 2), which is a good single and simple indicator to estimate it, since this parameter depends mainly on the availability of grass and not on the needs of the animals.

IsPC = 0.143 * height + 0,233 (R^2 =0,65)

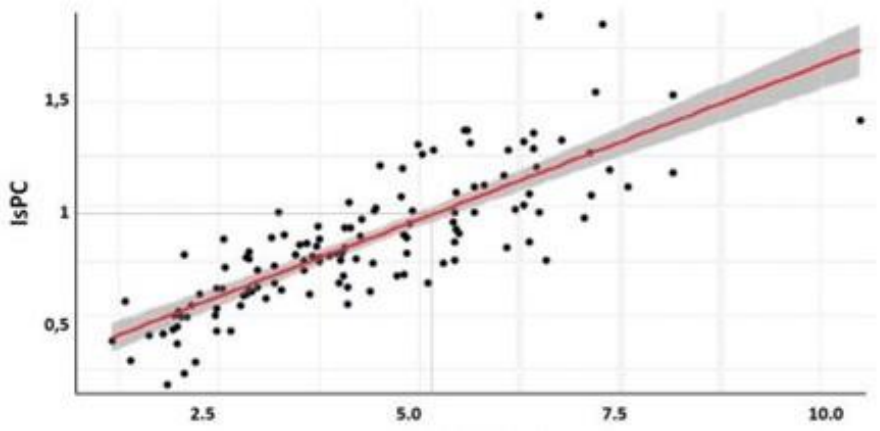

Figure 2.- Regression graph between height (cm) and IsPC

Table 2. The following recommendations arise from the application of the IsPC:

IsPC	Color	diagnosis	suggestions
> 1.2	Brown	excess forage, loss of quality	adjustments to manage excess feed and loss of quality
0.8 – 1.2	Green	optimal, complete plate	no immediate need for management changes
0.6 – 0.8	Yellow	caution, targets at risk	short term possible decisions
< 0.6	Red	danger, animals at risk	urgent decisions required

Discussion

By working for several seasons with producers and their families, who seasonally monitored pasture and livestock, calculated the IsPC on their farms and discussed alternatives to adapt to the situation, we were able to develop a simple and effective methodology so that each producer, accompanied by other producers and their technician, could identify and choose the best decisions to make.

The IsPC was an indicator designed in a participatory manner and is important for monitoring and adjusting the relationship between availability and demand for pasture, based on the seasonal objectives of each category. It is important to mention that to calculate it, it is necessary to measure the height of the pasture. This fact is fundamental to quantifying the availability of food to be distributed in the "meal plate" of the pasture. It is also interesting to note that the IsPC is directly related to the height of the pasture.

The scaling up and dissemination of the IsPC tool has developed the lessons learned:

- Producers' experiences of monitoring, IsPC construction and workshops were shared at field days to demonstrate the overall methodology and results.
- Three-day courses have been held, with the aim of developing the capacity to take the necessary measures to establish the IsPC and to identify measures to maintain the IsPC.

The difficulties in scaling up arise from the fact that it is a technology that involves the implementation of group spaces that create, and then reflect on, an objective index to identify appropriate management practices. It is necessary to adopt practices to measure pasture and livestock (the culture in this regard is insufficient) to then identify appropriate management practices according to the IsPC which relates the available forage to required forage.

Conclusions/Implications

Despite the challenges of scaling up IsPC with a necessary cultural shift towards systematic measurement, its implementation offers a valuable decision-making tool for producers. IsPC improves pasture and livestock management, ultimately contributing to more efficient and sustainable agricultural practices.

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