



## A quick meal plate index and its use as a decision-making tool for ranchers

Duarte, E<sup>1</sup>; Dieguez, F<sup>2</sup>; Pereira, M<sup>1</sup>

<sup>1</sup>Instituto Plan Agropecuario, Burges 3802, Montevideo, Uruguay, 11800; <sup>2</sup> Facultad de Veterinaria/UdelaR, Instituto de Producción Animal, Ruta 1 km 42.500, San José, Uruguay, 80100.

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### Abstract

In Uruguay, the forage base that feeds our herds and flocks is natural grassland. Research in the last 20 years has shown the importance of working with a greater proportion of grass to improve animal performance and make our systems more resistant and resilient to climate change. However, to date there has been no tool that allows for simple grass budgeting that can be used by livestock ranchers without major complications. With this objective, an index called the “Meal Plate Index” (MPI) has been developed in collaboration with ranchers, which, by estimating forage availability by measuring it with a ruler and comparing it with forage requirements by category, objective and season, allows us to know how well we are doing with grass in relation to the productive objectives we are trying to achieve. In practice, the difficulty is in making the grass field measurements. For this reason, and to move towards general application, a simplified version has been developed which, by means of visual estimation with self-calibration of the height of the sward and calculation of the stocking rate of the farm, can quickly and easily provide an estimate of how full the feed plate is that the animals need. The MPI tool, in both its regular and “quick” versions, was compared against external information provided by a national ranchers' network. The tool was adjusted to account for average and extreme forage conditions (both scarcity and excess) during its development and testing phases. The impact of using this simplified tool will improve the performance of ranching systems and for our national herd.

### Introduction

Uruguayan livestock farming is one of the main economic and land use activities (Paparamborda et al. 2023). The primary source of food for livestock on ranches is the native grassland, which is a heterogeneous resource, both in the seasons of the year (e.g. forage species and grazing management) and between years, due to climatic effects (Modernel et al. 2016). In this context, the Instituto Plan Agropecuario (IPA 2024) is the national extension agency for extensive producers, where it works with ranchers and other stakeholders on relevant issues for livestock production systems (Durate & Dieguez 2023). The IPA's activity is focused on extension activities, workshops and projects with producers and training activities on relevant topics for livestock production. Particularly, it is of interest to work in a participatory manner with the forage assignment at native grasslands in livestock production systems (Durate & Dieguez 2023). This

issue is more relevant in open-air systems, dependent on variable and extreme weather conditions. Adaptive management (Darnhofer et al. 2010) is important in a context of climate change, to enhance production systems resiliency in participative processes (Dumont et al. 2020). Likewise, it is of interest of IPA to generate quick tools for diagnosing of feed offered and required to help decision making about the actual and projected stocking rate and animal allocation. The estimation of forage availability and animal demand, as key factor of system productivity (Paparamborda et al. 2023), are crucial issues that can be implemented with the use of new information and communication technologies local and international impulse (MGAP 2024, UN 2024). In this work is presented a methodology which the “Meal Plate Index” (MPI) was participatively developed, and further development for a “quick MPI”, as prototype of an online decision-making tool.

### Methods

The MPI tool was developed within IPA participative project, where 18 ranches participated in 8 field workshops by farm (one by season in a 2-year period). The MPI consists of the ratio between forage allowance and animal requirements (Duarte & Dieguez 2023).

In the first version of MPI, a spreadsheet with inputs like animals’ number by category to calculate dry matter requirements, and paddocks grass height (GH) was developed. The GH was converted to DM offering by hectare using seasonal constants (250, 220, 250 and 215 kg DM/cm/ha for autumn, winter, spring and summer respectively; Duarte & Dieguez 2023). In those sessions training of farmers to data gathering, GH measurement skills, data input and results interpretation was carried out. To define cattle requirements, average forage availability was established according to the category and season (see Table 1). Also Stocking Rate (SR) was calculated using national definition of Gross Unit by hectare (GU/ha), being 1 GU the requirements of DM of a breeding cow with 380 kg of LV, that weans a calf by year (Berreta & do Nascimento 1991).

Table 1: Average forage allowance for cattle category by season expressed in kg DM by kg of liveweight (LW; Do Carmo et al. 2019).

Category	Autumn	Winter	Spring	Summer
Growing cattle (<300 kg LW)	3	3	2	3
Fattening cattle (>300 kg LW)	5	9	5	5
Breeding cows	5	4,5	6	5

In workshops instances, animals, paddocks and feed management information was discussed with stakeholders, according to MPI values. Some relevant workshops activity included the discussion with focus group of ranchers, analyzing together a particular farmer case, to achieve the adjusted SR (farm carrying capacity; Paparamborda et al. 2023) to cope climatic issues like drought episodes. To visualize results of MPI, ranges were defined values like a traffic light where values less than 0,6 had red color, ranges between 0.6 and 0.8 had yellow color, ranges between 0.8 and 1.2 had green color, and ranges more than 1.2 had brown color. These traffic light colors represent forage availability, but last range (>1.2) reflect a forage surplus with loss of quality, linked with pasture digestibility. In field workshops, ranch owners received other farmers in those activities, where seasonal field GH measurements, SR and MPI calculations were made, and finally discussions round were held to clarify grass and cattle management options to improve MPI, particularly in situations with values < 0.8. In other cases, where MPI was acceptable, success factors that explain results were also discussed inside focus group.

As a benchmark for tool use, MPI results were compared with external data from the farmers’ information-sharing network, which provides monthly updates on grass availability, climate conditions, and cattle status (RING 2024).

Since, in the development and validation processes some issues were detected on data gathering (mainly pasture objective measurements with a ruler), further development was made towards an easier decision-making tool. A “quick MPI” was developed using a two-entry table, presented in the next section.

**Results**

Table 2 presents MPI values for autumn and for breeding cows. Since several categories and paddocks combinations can be considered, infinite tables can be presented. Table 2 must be read as an example of a particular situation.

Table 2: MPI values for breeding cows in autumn in a double-entry table format.

		SR (GU/ha)							
		0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
GH (cm)	2	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3
	3	1	0.8	0.7	0.6	0.5	0.5	0.4	0.4
	4	1.3	1.1	0.9	0.8	0.7	0.6	0.6	0.5
	5	1.6	1.3	1.1	1	0.9	0.8	0.7	0.7
	6	1.9	1.6	1.4	1.2	1.1	1	0.9	0.8
	7	2.2	1.9	1.6	1.4	1.2	1.1	1	0.9
	8	2.5	2.1	1.8	1.6	1.4	1.3	1.2	1.1
	9	2.8	2.4	2.1	1.8	1.6	1.4	1.3	1.2

During project execution, farms with a “yellow” zone had lower forage supply than required and reduced their SR (e.g., selling culled cows) to transition to the “green” zone. Farms in the “green zone” could retain animals, sell tactically, and reserve paddocks while maintaining their status. Farms with a “brown light” used strategies like fattening culled cows and excluding paddocks for autumn reserves to transition to the “green” zone. However, these conditions, typical of prior spring-summer seasons, have been absent in several regions for years. In 2022/2023, a severe drought caused very low forage availability by autumn 2023 (INIA-GRAS 2024). Farms reduced SR (0.5–0.7 LU/ha), pasture heights rarely exceeded 4 cm, and MPI values were in “red” and “yellow” zones. Key tactical measures included selling animals, leasing land, and importing feed. Autumn paddock reserves for winter were not feasible, creating a winter forage deficit despite rainfall recovery. In 2023/2024, abundant rainfall (INIA-GRAS, 2024) led to record pasture growth in spring-summer and high forage availability by autumn 2024, with pasture heights of 7–10 cm and most MPI values in “brown” and “green” zones. Farms increased SR through animal retention, grazing sparse paddocks, and early protein supplementation. Strategic autumn reserves were unnecessary, as pastures maintained high heights, ensuring favorable winter forage conditions.

**Discussion and Conclusions**

Forage allowance is a key factor in improving the productive performance of systems (Do Carmo et al. 2019). In Uruguay, technical options to enhance productive and reproductive efficiency are well-known, a recent study by Paparamborda et al. (2023) indicates that producers often do not adopt these technologies due to various reasons. Molina & Álvarez (2009) argues that non-economic factors are associated with

decision-making and determine technological changes. In this context, participatory work with producers is an appropriate and well-valued tool, where peer-to-peer knowledge exchange is productive (Do Carmo et al. 2019, Paparamborda et al. 2023). Furthermore, according to evaluations conducted during workshops in this study, the objective of peer exchange was achieved through the development and application of the MPI. This index, which is easy to implement, facilitates pasture monitoring and forage allocation for livestock. During workshops where MPI was applied, discussions extended beyond production objectives, encompassing the broader goals of the family-farm system. Various technical alternatives were outlined to improve outcomes and achieve specific goals. The MPI's design aligns in some aspect with the co-innovation approach (Paparamborda et al. 2023), encompassing three domains: social learning, monitoring and evaluation dynamics, and complex adaptive systems.

On the other hand, Carballo & Severi (2024) highlight that even forage is crucial for livestock production systems, pasture measurement is not a common practice among producers. This motivated the creation of a Quick MPI, where training the eye to estimate pasture height, alongside SR estimation, simplified situational diagnostics. MPI is a situational index where low values may result from below-normal pasture growth in previous seasons (e.g., due to lower rainfall) or from excessive forage demand caused by overstocking. Identifying the "why" is the first step in discerning potential solutions.

The MPI tool, in both its regular and "quick" versions, was compared against external information provided by a national ranchers' network called RING (RING, 2024). The tool was adjusted to account for average and extreme forage conditions (both scarcity and excess) during its development and testing phases.

The workshop environment facilitated the development of MPI, reflection, identification of alternatives, actions, and learning. This space for co-creation of knowledge accelerated adaptation processes for managing in uncertain and changing environments. In this regard, the MPI tool enhances group discussions by situating participants in the real-world context of their situation. When producers recognize they have a problem, it initiates technical change dynamics as they seek more information, plan alternatives, and select a course of action. Currently, a mobile application for Quick MPI is being developed, featuring simple data input (e.g., category, number and weight of animals, and pasture height by paddock). The goal is to scale this tool to a broader audience.

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