



Development and implementation of a forage management platform in Uruguay ('iPasto').

Abstract

Introduction

Methods

iPasto is a digital platform for data management (Lombardo 2021). It is a web application that allows recording, calculating and visualizing information for improving pasture management at the paddock and farm scale. It links management and productivity data of grassland and paddocks (lots or grazing areas) of a farm. The data recorded in the farm (paddock or field monitoring) and data from remote sensing generate real-time rangeland performance information, which is stored in a database for further analysis. The platform is divided into 3 modules. The first module is basic information, where the user configures his farm with his grazing areas; the second module is pasture monitoring; and the third is grazing areas monitoring. The forage monitoring allows, through the use of remote sensing and an ecophysiological model adapted from Monteith (1972), to estimate and visualize information on the Net Aerial Primary Production (NAPP) at the paddock and farm scale for the various forage resources from 2000 to the present day. The main outputs of this module are: 1-NAPP (kg DM). The 'Paddock Monitoring' module allows updating the status of the paddocks, as well as displaying the following outputs or global forage performance indicators on the farm: 2-Grass Availability (GA) at a point in time (kg DM/ ha); 3-Meal Plate Index (MPI), an index which compares the forage or grass available with that required for optimal livestock performance (Duarte 2020), . The result is expressed in decimal,; an MPI value of 1 means that the available grazing area equals that needed, while lower or higher values show shortages or surpluses respectively. 4- Proportion of area available for grazing at different forage height (*i.e.* generated from the proportion of area at three height ranges); this variable has three indicators: proportion of area with forage height < 2.5 cm'(PGR-2.5), 2.5 to 5 cm(PGR2.5To5) and > 5 cm(PGR5).

iPasto is developed following a basic Client-Server architecture. The website is developed using the ReactJS framework, also in JavaScript. This unifies the use of a single language for both components of the application. The database is SQL and MySQL is used to implement it. Pipelines were developed to implement CI/CD to streamline the deployment/testing/put into production process. This software gives the possibility to capture information with the desired frequency and generate a database in real time. The implementation of iPasto accumulates more than 2 years of use from June 2021 to March 2023. After the work of dissemination and training in the use of the platform, its implementation begins with 25 farms which are members of the Grassland Management Project FPTA No. 356 (Pereira Machin 2020) executed by the Instituto Plan Agropecuario (IPA). This program is extended now to more than 400 producers associated with the institution. For the descriptive analysis of its main outputs, we used the 2021-2022 and 2022-2023 seasons for the group of initial establishments of the monitoring proposal.

Results

The iPasto platform is available for users registered in Instituto Plan Agropecuario. The results in Table 1. show that the grasslands aboveground net primary productivity (NAPP) was 4534 kg DM/ha. Grass Availability (GA) was 950 KgDM /ha. The Meal Plate Index (MPI) was 0.75 and the proportion of the ranch with forage height > 5 cm (PRG5) was 27%. Meat productivity (MP) was 109 kg/ha, NAPP required to produce one kg of meat (GMP) was 46 and Meat production efficiency by stock (MPES) was 165 Kg MP for US.

PRG5 (in Figure 1) indicated there are 3 groups (High, Medium and Low Systems). High systems (PRG5=60%): GA=1440, MPI=0.85 MP=153, GMP=30, Meat production by stock unit (MPES)=175, SU=1, mainly integrated by rotational grazing management and continuous grazing with resting. Medium systems (PRG5=22%): GA=886, MPI=0.72, MP=99, GMP=51, MPES=128, SU=0.84, mainly integrated by continuous grazing with breaks (grazing with rest periods, no grazing). Low systems (PRG5=5%): GA=642, MPI=0.71, MP=87, GMP=50, MPES=154, SU=0.6, correspond mainly to continuous grazing. Therefore, high systems have the best values for grass use efficiency (GMP and MPES), linked to improved values of GA, MPI, PRG5, MP and SU. In low and medium systems, MP and MPES are improved when MPI, GA and SU are improved and when a rotational grazing module is included in the continuous grazing. There is a positive trend in the MPES as MPI gets higher in March and June for all the ranches.

Table 1. Index averages 2021/2022 and 2022-2023

	2021-2022	2022-2023	AVERAGE
NAPP (KgMS/ha/year)	4901 [3290-6558]	4167 [2163-5226]	4534
GA (KgDM/ha)	1015 [336-3415]	885 [208-1951]	950
MPI [0 To 1.2]	0.79	0.70	0.75
SU (KgLive Weigh)	307	323	315
MP (Kg/ha/year)	113	105	109
GMP (KgDM/Kg of MP)	46	47	46.5
MPES (Kg/Stock Unit)	149	141	145

(NAPP: aboveground net primary productivity, GA: Grass Availability, MPI: Meal Plate Index, SU:Stock Animal Unit, MP: Meat productivity, GMP: ANPP required to produce one kg of meat MPES: Meat production efficiency by stock)

Discussion

iPasto is a tool that allows data capture and generates simple indicators that assist in the management of forage resources. The database is enriched daily, which offers the possibility of including artificial intelligence (AI) to develop automatic processes that improve accuracy in the estimation of existing and future indicators. It has the potential, through scaling up to the national level, to become a free platform with institutional backing and support to improve decision-making in adaptation processes and contribute to efficiency in the use of forage. High systems have the best values for grass use efficiency (GMP and MPES), linked to improved values of GA, MPI, PRG5, MP and SU. In low and medium systems, MP and MPES are improved when MPI, GA and SU are improved and when a rotational grazing module is included in the continuous grazing. There is a positive trend in the MPES as MPI gets higher in March and June for all the ranches.

Average PGR5, Average PGR2.5To5 y Average PGR-2.5 por IdRanch

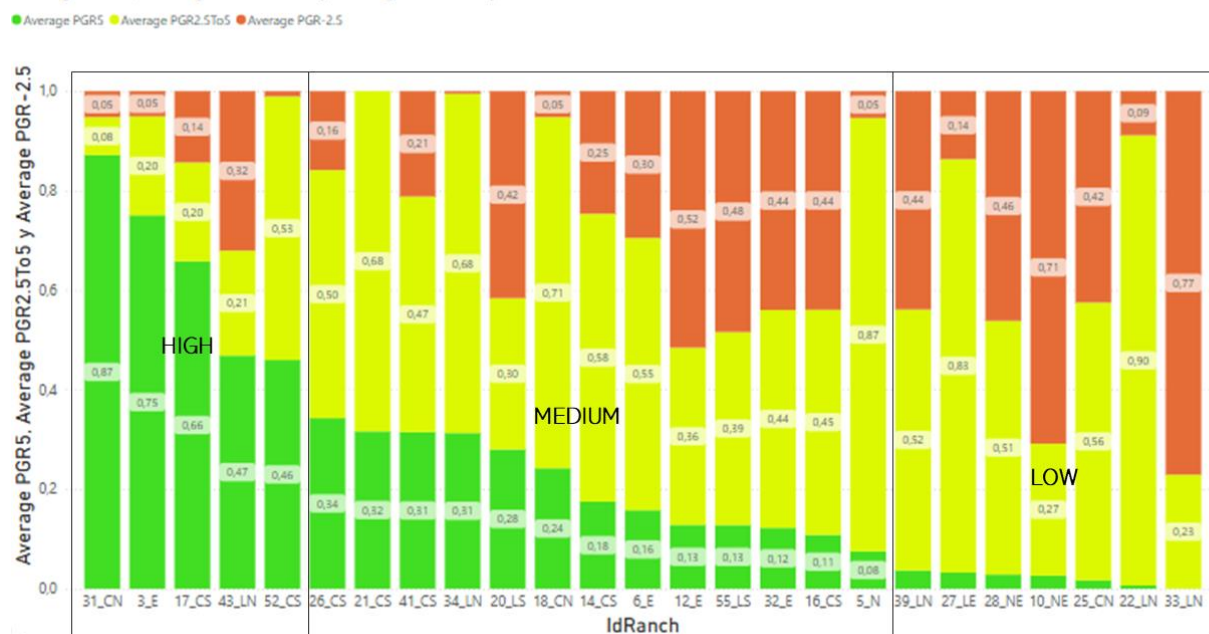


Figure 1. PGR5 evolution 2021/2022 and 2022/2023 by 25 ranches.

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