EDAPHOCLIMATIC ASPECTS THAT JUSTIFY PASTURE IRRIGATION IN THE CERRADO BIOME

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ABSTRACT

Brazil is a country with great water availability, despite being poorly distributed along its extension, and this resource is indispensable for life. The Cerrado is a biome that occupies approximately 24% of the Brazilian territory, holding a vast diversity in fauna and flora, in addition to having great hydrological potential. The present work aimed to address the biotic and abiotic factors that can influence the decision-making aspects of water use in Brazil for irrigation of tropical pastures in the Cerrado biome. Most pastures are found in the Cerrado biome, and have some stage of degradation, directly affecting forage production. When water becomes a limiting factor for the growth of the forage canopy, the use of irrigation is necessary, being an investment that can present positive results, in increasing forage production and consequently in animal productivity.

Keywords: Water. Fodder. Water potential. Seasonality.

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INTRODUCTION

Brazil has approximately 12% of all fresh water on the planet. Data presented by the National Water Agency (2019) report that by 2030 the demand for water use is expected to increase by about 30%. The country has a large territorial extension with regions with a diversified climate, requiring measures that help in the cultivation of forage plants.

The Cerrado plays a fundamental role in maintaining the water resources of Brazil and the continent. This biome is the cradle of the waters that feed three of the most important aquifers in the country: the Guarani Aquifer, the Bambuí Aquifer and the Urucuia Aquifer. These aquifers are true underground treasures of fresh water, which play a crucial role in the formation and supply of rivers that help maintain water throughout South America. This abundance of water resources in the Cerrado maintains the availability of water throughout the year, not only for the surrounding areas, but also for distant regions of the country. The Cerrado vegetation acts as an important regulator of the water cycle, contributing to the recharge of underground aquifers and to the stability of the rainfall regime in several parts of the country (De Souza *et al.*, 2019).

The Midwest region, in particular the state of Goiás, has two well-defined seasons of the year, one dry and cold, and the other hot and rainy characterized as summer. The distribution of rainfall is regular and concentrated in the months of October to March, with seasonal variations of scattered rainfall in April. Temperatures range from 22.1° to 24.1° C in the rainy months and dry winter months from 25.4° to 24.1° (Cardoso, Marcuzzo and Barros 2014).

And among the regions of the state of Goiás, milder temperatures can be observed. In this context, irrigation has the function of artificially providing water for commercial crops and pastures formed by tropical grasses, aiming to supply the lack of water through the irrigation system, but the edaphoclimatic characteristics of the region must be observed together with local climatology, focusing on the analysis of minimum night temperatures (Rocha *et al.,* 2007; Santos *et al.,* 2021).

According to Artaxo (2022), it highlights some criteria for implementing irrigation in pastures, such as the analysis of investment versus profit, with water deficiency being the main factor for the implementation of this technology, associated with the edaphoclimatic conditions of the region.

For an efficient forage management, the lack of regular rainfall can minimize satisfactory forage growth, which justifies the implementation of the technique, in an evolutionary scale of pasture production, irrigation is at the last step of technification of the pastoral environment.

In view of the above, the work aims to study whether there are edaphoclimatic conditions that justify the implementation of the irrigation system of tropical grasses in the Cerrado in order to improve forage production and meet the need for water during the period of productive seasonality of grasses.

THE CERRADO BIOME AND BIODIVERSITY

Brazil encompasses six distinct biomes, namely: the Amazon, the Caatinga, the Cerrado, the Atlantic Forest, the Pampa, and the Pantanal (Silva et al., 2021). Each of these biomes has a significant diversity of characteristics, such as climates, reliefs, soil types, vegetation, and wildlife. Vegetation, in particular, plays a crucial role, since its state of conservation and continuity has a decisive impact on the creation of *habitats* for species, the provision of essential resources for the survival of human communities, and the maintenance of ecosystem services (Carneiro, 2022; Cruvinel *et al*., 2022).

The characteristic vegetation of the Cerrado is adapted to the conditions of the biome, and thus plays a crucial role in the maintenance of aquifers and in the regulation of the water cycle, ensuring the sustainable availability of water for the country. Therefore, the preservation and responsible management of this biome are vital for Brazil's water security and sustainability (De Souza *et al*., 2019).

The Cerrado is often nicknamed the "water tank of Brazil" being the second largest biome, occupying 21% of Brazil's land, surpassed in extent only by the Amazon. In addition, it is widely recognized as the last agricultural frontier on the planet. In the country there are sources of important rivers such as the Xingu, Tocantins, Araguaia, São Francisco, Parnaíba, Gurupi, Jequitinhonha and Paraná rivers. As it is a region with high altitude located in the center of the country, this biome has great relevance in the distribution of water resources (Lima, 2011).

The term "Cerrado" is often used to refer to a diversity of ecosystems, which include savannahs, forests, grasslands, and gallery forests, present in the Central Brazil region. The biome, due to the fact that its extensive area is home to the springs or watercourses of eight of the twelve river basins present in the country, clearly demonstrates the socio-environmental relevance of the characteristics of the Cerrado (Cruvinel *et al*., 2022).

The extension of the Cerrado covers a large portion that encompasses the states of: Goiás, Tocantins, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Bahia, Maranhão, Piauí, Rondônia, Paraná, São Paulo and the Federal District. In addition, there are enclaves in the states of Amapá, Roraima and Amazonas. In this way, these areas are inhabited by traditional populations who make use of the available natural resources (Borges, Leite and Leite 2017).

This biome plays a fundamental role in subsistence and economy, since at least 300 of its plant species have varied uses in food, medicine and trade (Bolfe *et al.*, 2020). The biome stands out for housing about four thousand caves, corresponding to 60% of all caves found in Brazil (Bolfe *et al.*, 2020). In addition, its water sources play a vital role in energy generation, meeting the needs of nine out of ten Brazilians (Águas, Laranjeira, and Silva, 2021).

From the perspective of biological diversity, the Brazilian Cerrado stands out as the richest savanna on the planet in diversity. This ecosystem is home to an impressive variety of 11,627 species of native plants already cataloged, which is testimony to its biological richness. In addition, it offers a wide diversity of *habitats*, resulting in a remarkable alternation of species between their distinct phytophysiognomies. This diversity is fundamental not only for nature conservation, but also for scientific research and ecotourism, highlighting the importance of the Cerrado in the global scenario of world biodiversity (Queiroz, 2009).

In this way, the Cerrado is a true treasure of biodiversity, in relation to fauna, we find approximately 199 species of mammals, while avifauna, in turn, impresses with about 837 different species. In addition, the numbers of fish, reptiles and amphibians are explored, and equally remarkable figures are found: 1200 species of fish, 180 of reptiles and 150 of amphibians. This diversity is even more special when observing the number of endemic species, that is, those found exclusively in the region. In the case of amphibians, this number reaches 28%, and for reptiles, it reaches 17%, emphasizing the unique role of the Cerrado in the preservation of these groups (Prestes, 2021; MMA, 2018).

It is estimated that 13% of butterflies, 35% of bees and 23% of tropical termites find refuge in this biome. These figures highlight the relevance of the Cerrado not only at the national level, but also globally, as a *biodiversity hotspot* that deserves continued protection and conservation (Prestes, 2021; MMA, 2018).

Thus, the Cerrado is not only a sanctuary of biodiversity, but also a guardian of water resources, the preservation of which is vital for environmental sustainability and human well-being in South America. Therefore, the conservation of this biome is crucial to ensure the availability of freshwater in the long term (De Souza *et al.*, 2019). In view of the exposure, a local study of water availability must be carried out to insert an irrigation system that does not cause environmental impact on the Cerrado biome.

THE CLIMATE

The purpose of a climate classification is the efficient organization of information, in order to make it accessible and applicable in a simple and comprehensive way (Steinke, 2004). To achieve this goal, these classifications are based on statistical techniques that play a key role in the delimitation of climate categories. These categories are useful in various applications, satisfactorily meeting different needs (Steinke, 2015). In this way, these classifications serve as valuable tools for scientists, production managers, farmers, and other professionals who need to understand and make decisions based on local climate conditions (Silva, 2022).

The climatic units resulting from a climatic classification perform a general understanding of the climatic behavior in various regions. This implies that these climate categories not only simplify the complexity of the climate, but also provide an effective means of communicating and understanding weather patterns in different localities (Werneck, 2012). They are decision-making tools in the implementation of techniques of planting, irrigation, management, harvesting, productive prediction and economic expectation in each region associated with the vegetable crop to be planted.

The regions of Brazil have a diversified climate. The Midwest region has heavy rainfall in the summer and absence of it during the winter (Vilela Júnior, 2023). Thus, the Cerrado biome, according to the Köppen classification, has two types of predominant climate. The first of them is the Cwa (Subtropical dry winter climate), characterized by an average temperature of the coldest month below 18ºC and that of the hottest month above 22ºC.

The second is the Aw climate, which refers to the humid tropical climate of the savannas with a dry winter, highlighting the presence of rainfall concentrated at certain times of the year. This climatic diversity is one of the striking characteristics of the Cerrado, influencing its flora, fauna, and ecosystems (Nascimento and Novais, 2021).

The specific climatic factors in the Cerrado include the seasonality of rainfall, with well-defined dry and rainy seasons. During the dry season, the biome can be impacted by frequent fires, which are a natural component of the ecosystem and play a role in vegetation renewal. These characteristics, for the pastoral environment, have a great impact on forage production due to the absence of rainfall and in some regions of the Cerrado temperatures can reach below 12ºC at night, affecting the growth of tropical pastures (Dornas *et al.,* 2022).

The growth of forage plants does not occur uniformly, their production is higher during spring-summer and lower between autumn and winter. Temperature is related to the efficiency of metabolic processes, with the base temperature for most forages between 30°C and 35°C (Mendonça and Rassini, 2006) below that between 12°C and 16°C can affect, in addition to enzymatic processes, it can cause the death of the aerial part, directly affecting plant growth (Perez, 2008).

SOIL CHARACTERISTICS

The Cerrado is a biome characterized by diverse vegetation, composed of low trees, shrubs, and grasses. The central region of Brazil covers a large part of this biome, and the soils found in this area are the subject of study due to their importance for agriculture. The soils found in the central region of Brazil, which encompasses the Cerrado, generally stand out for their remarkable infiltration capacity and the significant presence of macroporosity, despite the high clay content. Although they have such characteristics, the practice of intensive agriculture in these areas has required soil conservation techniques to protect from erosive processes (Monteiro and Falcão, 2022).

Thus, it is understood that most of the soils in the Cerrado region are classified as Latosols, which are characterized by being very deep, porous, with an easy drainage process and consist of being well permeable with high potential for agriculture. About 46% of the soils of the Cerrado biome are consistent with these characteristics, the others correspond to quartz sands (15.2%), podzolic sands (15.1%), plinthosol (9%), litholic soils and lithosols (7.3%) and other soils (3.1%) (EMBRAPA, 2013).

The variation in the color of this type of soil varies from red to yellow, presenting high acidity, toxicity and deficiency of essential nutrients such as: calcium, magnesium, some micronutrients and potassium. Even in the face of such characteristics, these types of soil have adequate physical conditions for planting (EMBRAPA, 2013).

The advance of extensive agriculture in the soils of the Cerrado is an undeniable reality, and the State of Goiás emerges as a protagonist in this context, standing out nationally for its economy focused primarily on agriculture and cattle production on pasture (Da Silva, De Souza Silva and De Souza, 2022).

Thus, understanding these physical and water properties is crucial to promote sustainable agricultural practices, ensuring soil preservation and mitigating potential environmental impacts. The continued study of these soils will contribute significantly to the development of innovative and balanced approaches, allowing agriculture in the region to thrive in a resilient manner that is harmonious with the surrounding environment (Ribeiro *et al.*, 2022).

The soils of the Cerrado mostly have low chemical fertility, restricting plant growth limiting the expression of the genetic potential of forage plants. The erroneous idea was created that pasture is that crop that supports extractivism without the proper replacement of nutrients, as it happens with other Brazilian crops. With this thought, for decades the management carried out was minimal, which did not help in the longevity of pastures, such as the practice of burning and consecutive mowing. The lack of necessary care with investments in fertilizers caused serious problems of degradation of pastures and soil (Vilela Júnior and Vilela, 2002).

Vilela *et al.* (1998) stated that for the implementation of forage crops it is necessary to consider their establishment and maintenance. For a good development of the vegetation, there are several nutrients necessary, with phosphorus (P) being the most important of them, along with nitrogen and potassium, analyzing that each forage has its nutritional needs, and the more developed the root system, the greater its use of soil profile extracts. Thus, the propagation of the genus *Urochloa* was a viable alternative for the soil and climate characteristics present in the Cerrado biome.

VEGETATION

The Cerrado biome has a great diversity of landscapes that include savannas, forests, and grasslands, with savannas being the predominant form of vegetation cover, representing about 70% of the phytophysiognomic composition of the Cerrado (Trentin *et al*., 2021).

These areas are characterized by small shrubs with tortuous trunks that branch out in an irregular manner. The adaptation of these plants to drought and fire is remarkable and is reflected in their morphophysiological characteristics, which allow them to survive in challenging conditions (Sano *et al*., 2020).

Thus, it is considered that the Cerrado biome is a region of remarkable ecological diversity, as it is characterized by a mosaic of various types of vegetation. This diversity is the result of the complex interaction between several factors, including the heterogeneity of the soils, the varied topography, and the different climates that cover this extensive area. Many species that inhabit the Cerrado have developed mechanisms of resistance to fire, neglect and ramoneio, becoming essential for the maintenance of this ecosystem. In addition, these plants often rely on a period of drought to induce flowering and fruit, which is intrinsically linked to the drop in temperature and seasonal climate change (Carvalho, 2009).

The root system of Cerrado plants is remarkable, with a main root usually larger than the others, which penetrates vertically into the soil. From the taproot, lateral roots emerge, which also branch out. This complex root system allows trees and shrubs to maximize water uptake, taking advantage of the reserve that accumulates in the water tables (De Oliveira, 2020).

In this way, the Cerrado landscape becomes a reflection of the numerous adaptations that the local flora has developed over millennia to survive in different conditions. The variety of vegetation types, which include savannas and gallery forests and Cerradão, is a testimony to the natural richness of this region. Therefore, the preservation of this ecological mosaic is crucial to maintain the ecological integrity of the Cerrado and ensure the continuity of its invaluable environmental services (Martins *et al.*, 2022).

In the 1940s, the opening of the Cerrado began, eliminating native trees and giving way to rice agriculture and soon after the planting of forage. One of the main problems faced in Brazil was the implementation of agriculture through exploitation and extractivism (Borghi *et al.*, 2018). In the 1970s, cattle ranching expanded due to the incentive to credit and low land values (Peron and Evangelista 2004).

The Cerrado biome from that date on had the presence of plants introduced for the purpose of feeding cattle, since native pastures were not sufficient for profitable production of cattle raised on pasture, mainly of the genus *Urochloa,* in warmer regions, due to their high adaptability to soils with low fertility and excellent forage production (Kluthcouski *et al*., 1991).

THE GENUS *UROCLOA*

The *genus Urochloa* is the most cultivated forage in Brazil, providing important species of forage for tropical climate regions, especially *Urochloa brizantha* cv. *Marandu* with an estimated 80 million hectares planted, which corresponds to an average of 70% of the entire cultivated area in the country. The main characteristic is its high adaptability to different types of soils (Seiffert, 1980, Pari *et al.,* 2010).

The origin of this genus was in South Africa, arrived in Brazil around the 1960s brought from French Guiana through the Northern Agricultural Research and Experimentation Institute (IPEAN), located in Belén – PA for use in tests as forage, later expanded to all of Brazil (Raposo *et al.,* 2023).

They are plants with large characteristics adaptation to soils of medium fertility, high tolerance to high levels of aluminum and low levels of calcium and phosphorus. The germination time of the seeds varies between 90 and 120 days and should be planted preferably in rainy seasons, which can reach up to 1.5 m and still has a high production of dry matter (Bezerra *et al.,* 2020; Seiffert 1980).

One of the problems that hinder the growth of forages is seasonality, especially in tropical species, during the dry season that varies from July to December. As an alternative to increase forage, irrigation becomes an efficient method (Andrade *et al.,* 2009).

Studies carried out by Andrade *et al.,* (2009) and Dantas *et al.,* (2016) demonstrated an increase in forage production, dry matter and greater height in the plants studied, positively affecting grasses of the *genus Urochloa*, showing an increase of 288% when cultivated under irrigation systems.

Studies carried out by Rigotti *et al.,* (2019) in perennial pastures in the southern region of Brazil during the summer with the species *Cynodon dactilon sp. cv. Jiggs, Cynodons sp. cv. Tifton 85, Pennisetum purpureum Schum. cv. Pioneer, Urochloa brizantha cv. MG5 Vitória, Megathyrsus maximum Jacq. cv. Aries* showing higher dry matter productions.

Silva *et al.,* (2020) through the use of irrigation on the residual straw of *Urochloa ruziziensis* provided a significant increase in the mass of soybeans. Melo *et al.,* (2020) through fertilization and drip irrigation showed increases in productivity and height of the forage *Urochloa Brizantha* with reference evapotranspiration depth of 31.96% and 41.28%.

The genus *Urochloa*, has positive responses to the technological increase adopted in the pastoral production system, presents an excellent option for pastures of low and medium production. Being responsive to irrigation and fertilization, but adapts well in low productivity systems, this phenotypic plasticity brings stability to the production system without major losses due to management changes, for example. However, the pace of plant growth must be respected, due to the management adopted, the correct fertilization to replace the extracted nutrients, and grazing to avoid the degradation of the pastoral system (Silva *et al.,* 2020).

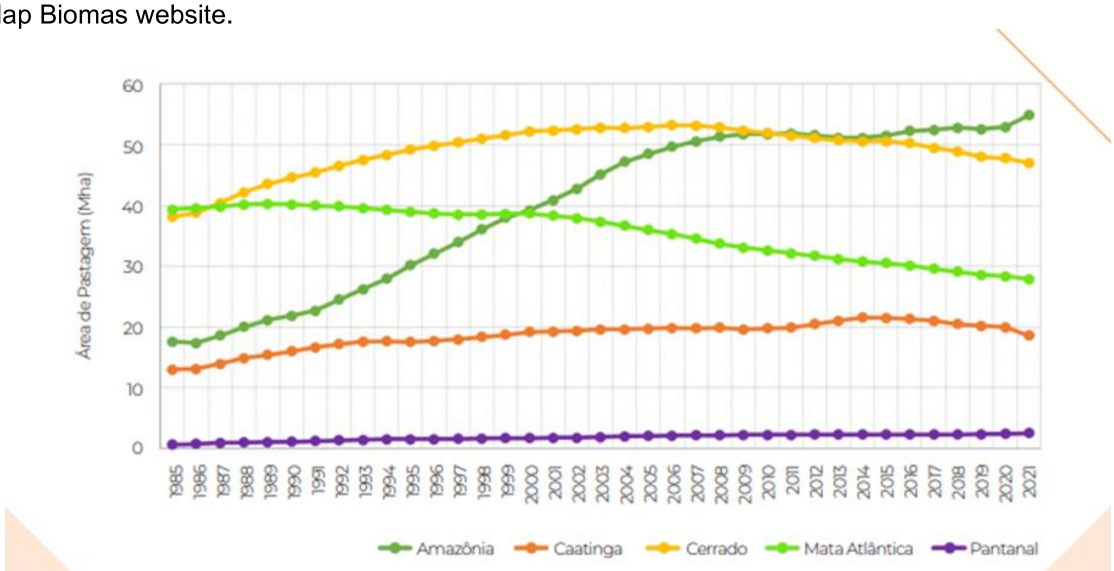
CAUSES OF PASTURE DEGRADATION IN CERRADO SOILS

Brazil has a large territorial extension, occupying the fifth position in the world ranking, being the largest in the Southern Hemisphere, with approximately 851 million hectares, which are divided into permanent reserve areas, forests, pastoral, agricultural and urban areas, of the total value 66.3% have native vegetation (Reis *et al.*, 2017; Miranda, Amaral and Sousa, 2021).

The livestock activity has grown over the years, with the degradation of pastures being one of the limiting factors for the development of the activity, directly affecting the production of meat and milk with the feeding of animals exclusively in pastures, in addition to the productive seasonality of tropical grasses in the period of scarce rain in the Cerrado region. Government interventions are needed to prevent its worsening, through incentives to implement management techniques that can minimize and solve the causes of degradation in the short and long term (Almeida, Simões, and Ferraz, 2019; Borghi *et al*., 2018).

The data presented by MapBiomas (2022) point out that in the last 36 years there has been an increase of about 39% in Brazilian pastures, with the Amazon being the biome with the highest percentage of planted pastures, which is due to the fact that government initiatives and soil potential help. The land is mostly occupied by extensive cattle ranching (Lange *et al*., 2019), followed by the Cerrado and Caatinga, according to figure 1.

Figure 1. Increase in the number of pasture area in Brazilian biomes between the years 1985-2021 according to the Map Biomas website.



Source: MapBiomas (2022).

According to Carvalho *et al*., (2017) on average 80% of Brazilian pastures have some stage of degradation, as well as Macedo, Kicher and Zimmer (2000), Terra *et al*., (2019), cite that this is a gradual process which can cause a reduction in productivity and fertility, directly affecting animal performance.

According to Dias-Filho (2017), four criteria were established to analyze the levels of degradation according to their stage in pastures, as follows (Table 1):

Table 1: Soil degradation stage levels according to Dias-Filho (2017)

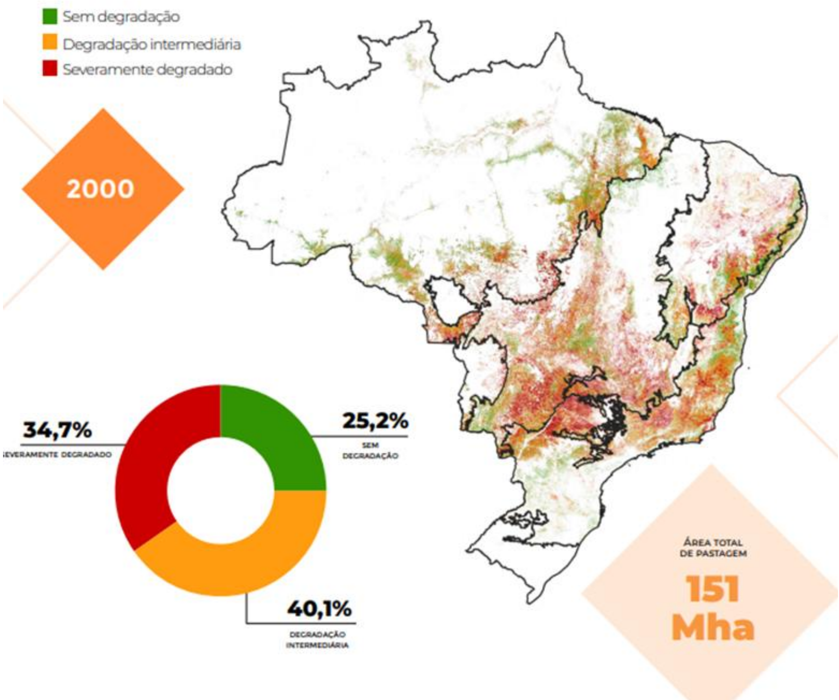
Degradation Levels	
Level 1	Leve which has still fertile pasture, with bare soil and invasive plants.
Level 2	Moderate- there is increased weeds and soil exposure.
Level 3	Strong, it has a low percentage of forages, excessive increase of weeds.

Level 4	Very strong, the presence of forage plants may or may not occur, with signs of erosion (biological degradation) and predominance of bare soil.

Among the factors that can lead to degradation, the following can be mentioned: anthropic actions, erosion, leaching, poor quality seeds, soil compaction, overgrazing, which act together or in isolation, leaving the plants susceptible to diseases and invasion by weeds, generating losses to both the producer and the animals. In addition to the damage to the environment, favoring deforestation actions for the opening of new productive areas, due to the consequences of low pasture production (Ferreira *et al*., 2014; Carvalho *et al.*, 2017; Silva *et al.,* 2018; Ferreira and Neto, 2018).

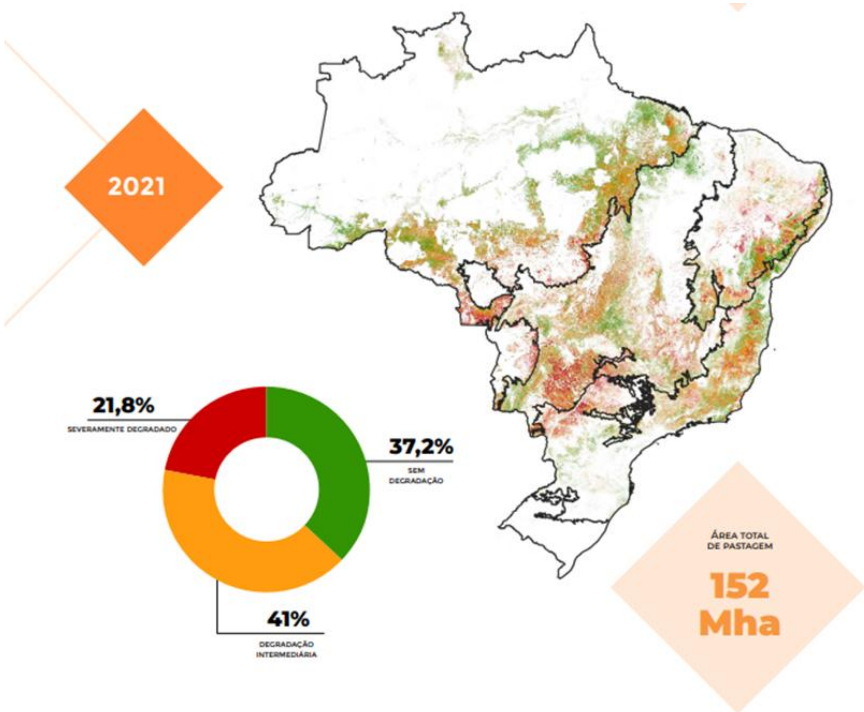
The analysis of satellite images collected on the MapBiomas website (2022), between the years 1985 and 2020, it was possible to verify a drop in the percentage of degradation of 70% in the year 2000 with a reduction to 53% in 2020. Pastures in a severe stage of degradation constituted 29% of the pastures, with a reduction to 14% (MAPBIOMAS, 2022), as can be seen below in Figures 2 and 3.

Figure 2. Map of Brazil comparing the level of degradation of Brazilian pastures between the years 2000 and 2020.



Source. MapBiomas, 2022.

Figure 3- Map of Brazil comparing the level of degradation of Brazilian pastures between the years 2000 and 2020



Source: MapBiomas, 2022.

The physical and chemical aspects of the soil, the nutritional status of the plants and the carrying capacity must be analyzed before the implementation of livestock activity, so that there is no drop in animal productivity. Some measures can be taken by producers in order to avoid degradation, such as: the correct choice of grass to be established, the correct management of grazing, adjustments in the stocking rate according to the time of year, monitoring the natural fertility of the soils and its correction according to the requirement of the grass chosen for the formation of pastures, identify the causes that are causing degradation, associated with the use of technologies, analyzing some factors such as: climate, soil, type of animal and management system (Macedo, Kichel and Zimmer, 2000; Macedo *et al*., 2012; Terra *et al.,* 2019).

For the productive adjustments of areas that present some stage of degradation, there are techniques such as the recovery and renewal of pastures can occur in two ways: direct or indirect. Authors such as Terra *et al.*, (2019) point to positive results with the use of forage legumes in the recovery of Brazilian pastures, as well as Silva *et al.,* (2017), with the association of corn with *Urochloa brizantha cv. Marandu and pigeon pea,* which demonstrated as a post-harvest result the increase in the amount of biomass and the availability of food to the animals.

The highest concentration of pastures is found in the Cerrado ecosystem. When related to agricultural production and sustainability, pasture degradation becomes a worrying factor, since livestock activity is based on pastures, which directly affects the quality of animal production (Macedo and Araújo, 2019). Data from the Food and Agriculture Organization of the United Nations (FAO) estimate that in Brazil, on average, 60% to 80% of pastures are in some stage of degradation.

Among the factors that accelerate the degradation process, lack of fertilization, animal overcrowding, as well as practices of setting fires and consecutive mowing, can be mentioned. Fertilization is a way to maintain pasture productivity, but its use must be done by identifying the necessary nutrients in addition to economic viability according to the production system (Cabral *et al*., 2021).

FERTILIZATION AND IRRIGATION OF PASTURES

Since Brazil is one of the largest beef producers in the world, agriculture has always played an essential role in the country's development. An estimated 170 million hectares are used for the cultivation of pastures, as it is the cheapest way to feed ruminants and produce meat and milk. Brazilian soils have great diversity in fertility and the landscape is composed of native and cultivated pastures, but a major problem faced by Brazilian livestock is the degradation of pastures, which among its main causes can be cited low natural fertility, inadequate forage implantation, poor quality seeds, among others. As an alternative to improve forage production, the use of fertilizers and correctives is necessary (Francisco, Silva and Teixeira, 2017), with the expectation of improving productivity and productive gains per pastoral area.

To maintain quality soil, it is necessary to carry out care according to the needs of the soil. Pasture fertilization practices promote the maintenance of grazing plants, avoiding degradation processes, for this it is necessary to know the needs of each forage, ensuring the supply of nutrients (Macedo and Araújo, 2019).

According to Cabral *et al.,* (2021), the demand for the following nutrients should preferably be analyzed: phosphorus (P), nitrogen (N), potassium (K), and micronutrients. Phosphorus is needed mainly in soils with a deficiency of this mineral, grasses planted in soil with this deficiency have a 98.5% reduction in their production.

Nitrogen is one of the main nutrients, as it increases forage mass, leaf emission and can accelerate senescence due to the increase in the growth rate of the vegetable. Francisco, Silva and Teixeira (2017) state that potassium in Cerrado soils has a high fixation capacity and negatively affects the availability of this nutrient, in which case liming is a good option to reduce its fixation and provide good root development.

In addition to nutritional issues, the dry winter periods in the months of May to October are one of the problems faced for forage production, where there is a seasonal productive milestone. At this climatic moment, climatic factors may not all be available for the growth of forages such as water, so irrigation emerges as an alternative tool to meet this water need (Vilela Júnior *et al.,* 2019).

Analyzing the edaphoclimatic characteristics found in the Cerrado and in the state of Goiás, irrigation can be a tool to aid in the production of forage, and it is important to make a local study of the region in relation to the soil, analyzing physical and chemical aspects, the species of grass that will be planted or that is already established in the place, as well as the night temperatures in the coldest months of the year that corresponds to June, July and mid-August, verifying that temperature is not a limiting factor for forage growth. With this data, it is possible to outline a productive pasture strategy without affecting the environment, minimizing the productive seasonality of tropical grasses (Rocha *et al.,* 2007, Santos *et al.,* 2021).

Pasture fertilization has occurred more frequently and is being adopted in the management practices of medium to high forage production farms. When you have a rainfed pastoral system of medium to high production, you can invest in the implementation of one of the specific irrigation systems for pastures, being the last technology to be implemented due to its requirements and complexities, in addition to the edaphoclimatic conditions, forage and the qualification of the workforce.

FINAL CONSIDERATIONS

The Cerrado has two important climatic variations such as dry winter and rainy summer, this condition of two well-defined climatic seasons is accompanied by rainfall concentrated in some months of the year and drought with milder temperatures in other months.

These characteristics impact plant production in the dry season. It is necessary to implement productive techniques. Irrigation is a good tool to minimize productive seasonality, especially in tropical pastures. However, first, a survey of the productive conditions must be carried out, checking if there is any stage of degradation of the pastures. In addition to adopting techniques for maintaining and preserving the pastoral environment and only after implementing the pasture irrigation system.

Although the country has great water availability, a local climatological study, in addition to soil and grass type issues, is essential for the decision to install an irrigation project, as it may be faced with climatic limitations that directly affect the growth of grasses, making the implementation of the pasture irrigation system unfeasible.

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