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WATER RESOURCES IN AGRIBUSINESS IN THE INTERMEDIATE REGION PATOS DE MINAS

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ABSTRACT

The availability of water in the Brazilian territory directly contributes to the country being one of the largest food exporters in the international market. However, due to the unequal geographical distribution of water, among other aspects, not all Federation Units have highly productive regions. In Minas Gerais, for example, five Intermediate Geographic Regions represent the core of Minas Gerais agribusiness. In this context, this study aims to analyze how water resources are distributed and their use in agribusiness in the Intermediate Geographic Region of Patos de Minas. The methodological approach consisted of a bibliographic survey. After analysis, it can be inferred that the referred Region comprises 34 municipalities, part of which are inserted in the largest area of central pivot irrigation in the country, in addition to housing two of the three largest irrigating municipalities in Brazil, namely, Unaí and Paracatu. As for the distribution of water resources, in general, all municipalities have river courses that provide high cultivation of grains and other products, as well as the production of milk and dairy products.

Keywords: Food security. Irrigated agriculture. Conflicts over the use of water. Center centers. Water management.

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INTRODUCTION

Agribusiness encompasses the entire production chain of agriculture and livestock, from the manufacture of essential inputs, production and the procedures involved, to the final consumption of agricultural products (BIALOSKORSKI NETO, 1994). In the Brazilian territory, the expansion of agribusiness activities occurred due to several factors, namely, arable land with the proper soil corrections, transport logistics, technological modernization, energy demand, public policies to serve small, medium and large producers, in addition to an essential element in the entire production chain, which is the availability of water.

The water resources linked to the various production technologies collaborate for high agricultural productivity, meeting domestic and international demands. According to the Brazilian Agricultural Research Corporation (EMBRAPA, 2018, p.01): "The availability of natural resources, associated with public policies, technical-scientific skills and entrepreneurship of Brazilian farmers were fundamental for this agricultural development of the country". In Brazil and in other areas of other countries, according to the National Water Agency (ANA, 2018), water consumption for the agricultural sector is significant. Agriculture and livestock occupy approximately 38.2% of the earth's surface, and agriculture consumes 7.0% of the water in rivers and lakes, which represents 70% of the water consumed.

According to ANA (2021, p. 07), in Brazil, "[...] irrigation began in the 1900s for rice production in Rio Grande do Sul. The significant intensification of activity to other regions occurred from the 1970s and 1980s onwards". Since then, the irrigation poles have expanded, data from ANA (2018), indicate that agriculture occupies 9% of the immense territory, and the flows consumed for irrigation exceed 800 m³/s. The use of water reaches 80.7% of the total demand collected, of which more than 60% is destined for irrigation, 11.0% for animal consumption and less than 3% for human consumption.

> Irrigation is the largest use of water in Brazil and in the world, corresponding to half of the water withdrawn in the country. This use corresponds to the agricultural practice that uses a set of equipment and techniques to supply the total or partial water deficiency for crops, and varies according to the needs of each crop, type of soil, relief, climate and equipment. [...] Brazil has 8.5 million hectares (Mha) equipped for irrigation, 35% of which are fertigation with reused water (2.9 Mha) and 65% with irrigation from spring water (5.5 Mha) (ANA, 2021, p. 35).

Among the irrigation methods, four stand out: surface, underground, sprinkler and localized irrigation, but it is important to emphasize that there is no ideal method, as its use depends on a set of aspects, namely, type of land, how much the producer can invest, which species cultivated (...)

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> [...] mechanized irrigation methods and systems (i.e., without the surface method), it is observed that the most efficient groups in the use of water – localized irrigation (drip and micro-sprinkler) and sprinkler by center pivot – represented about 70% of the increase in irrigated area [...]. Among the other systems, sprinkling by winding spools (hydro roll) stands out with about 15% of the increase in equipped area in the period (ANA, 2021, p.30).

Specifically in Minas Gerais, the availability of water resources, among other aspects, will directly contribute to the formation of agribusiness centers with high productivity, as pointed out by the João Pinheiro Foundation (FJP, 2022, p.01), and the activities focus on the "[...] Intermediate Geographic Regions (RGInt) of Patos de Minas, Varginha, Uberaba, Uberlândia and Divinópolis". The referred RGInt are inserted in the São Francisco and Paraná Hydrographic Regions, which have a water system of great extension and complexity. In view of the above, this study aims to analyze how water resources are distributed and their use in the agribusiness of the RGInt of Patos de Minas.

METHODOLOGY

For the execution of this work, a bibliographic research was carried out, which covers the ...

> [...] bibliography already made public in relation to the subject studied, from individual publications, bulletins, newspapers, magazines, books, researches, monographs, theses, cartographic materials, etc. [...] and its purpose is to put the researcher in direct contact with everything that has been written, said or filmed on a given subject [...] (MARCONI; LAKATOS, 2017, p. 57).

Bibliographic searches were carried out on Google Scholar and journals of the Coordination for the Improvement of Higher Education Personnel (CAPES), using the following keywords: water resources, agribusiness and Intermediate Geographic Region of Patos de Minas. As criteria for the review, the researched material was evaluated, and those consistent with the proposed theme and the selected area were selected for reading. Thus, the authors who gave theoretical support were: Bialoskorski Neto (1994); Assad; Martins; Pinto (2012); Montoya and Finamore (2019); Rodrigues; Domingues (2017); Guimarães; Landau (2022); in addition to ANA's productions (2018, 2019, 2020, 2021 and 2022); EMBRAPA (2018); FJP (2021, 2022); Brazilian Institute of Geography and Statistics (IBGE, 2010, 2020, 2021, 2017); Minas Gerais Institute of Water Management (IGAM, 2022) and Brazil (2006).

Then, reflections, analysis of the information obtained, systematization, organization, elaboration of maps and structuring of the text were carried out. To prepare the maps, the

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Arcgis 10 software and a database in shapefile format, available on the websites of ANA, IBGE, IGAM, were used.

RESULTS AND DISCUSSION

CHARACTERIZATION OF THE INTERMEDIATE GEOGRAPHIC REGION OF PATOS DE MINAS - MINAS GERAIS

There are several criteria for regionalization of the territory, for this study, we opted for the division of hydrographic basins established by the National Water Agency (ANA), superimposed on the Regional Division of Brazil into Immediate Geographic Regions and Intermediate Geographic Regions, established by the IBGE (2017). The study area is configured in the municipalities of the Intermediate Geographic Region (RGInt) of Patos de Minas, inserted in the state of Minas Gerais, in the hydrographic basins of the Urucuia, Paracatu, Paranaíba and Araguari rivers.

According to the IBGE (2017, p.20), the Intermediate Geographic Regions:

> The Intermediate Geographic Regions correspond to an intermediate scale between the Federation Units and the Immediate Geographic Regions. Preferably, the delimitation of the Intermediate Geographic Regions was sought with the inclusion of Metropolises or Regional Capitals [...]. The Intermediate Geographic Regions organize the territory, articulating the Immediate Geographic Regions through a higher hierarchical pole differentiated from the flows of private and public management and the existence of urban functions of greater complexity.

The RGInt of Patos de Minas covers 34 municipalities inserted in three Immediate Geographic Regions: Patos de Minas, Patrocínio and Unaí.

> The Immediate Geographic Regions have the urban network as their main element of reference. These regions are structures based on nearby urban centers to satisfy the immediate needs of the populations, such as: purchases of durable and non-durable consumer goods; job search; demand for health and education services; and the provision of public services, such as service stations of the National Institute of Social Security (INSS), the Ministry of Labor and judicial services, among others (IBGE, 2017, p.20).

Due to the large territorial extension (586,513.983 km²) of Minas Gerais and the high number of municipalities (853), the IBGE (2017) regionalized the state into 13 Intermediate Geographic Regions (Figure 1) and 70 Immediate Geographic Regions.

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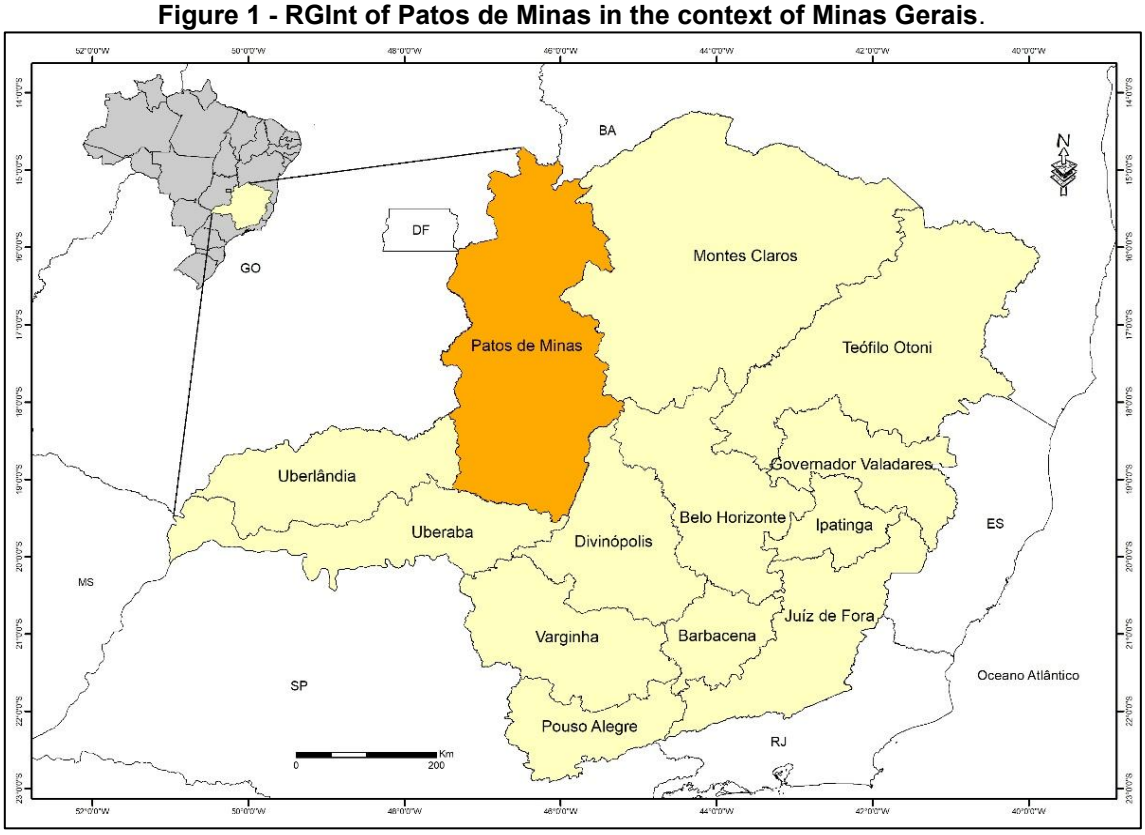
Figure 1 - RGInt of Patos de Minas in the context of Minas Gerais.



Source: IBGE, 2017. Org: SOARES, I. L.O., 2022

The RGInt of Patos de Minas borders with municipalities of the RGInt of Uberlândia, Belo Horizonte, Montes Claros, Divinópolis, Uberaba; with municipalities in the states of Bahia and Goiás, in addition to Brasília - Federal District. The distribution of municipalities in the RGInt of Patos de Minas is unequal, since it follows the urban hierarchy, as already mentioned, with five municipalities in the Immediate Geographic Region of Patrocínio; eleven in the Immediate Geographic Region of Unaí and eighteen in the Immediate Geographic Region of Patos de Minas.

The Immediate Geographic Region of Patrocínio covers the municipalities of Patrocínio Coromandel, Serra do Salitre, Guimarânia, Cruzeiro da Fortaleza. The Immediate Geographic Region of Unaí comprises the municipalities of: Unaí, Buritis, Urucuia, Arinos, Formoso, Riachinho, Cabeceira Grande, Bonfinópolis de Minas, Dom Bosco, Natalândia and Uruana de Minas. The Immediate Geographic Region of Patos de Minas includes the municipalities of Patos de Minas, Paracatu, João Pinheiro, São Gotardo, Carmo do Paranaíba, Vazante, Presidente Olegário, Lagoa Formosa, Brasilândia de Minas, Rio Paranaíba, Lagoa Grande, Lagamar, Tiros, Guarda-Mor, São Gonçalo do Abaeté, Varjão de Minas, Matutina and Arapuá (Figure 2).

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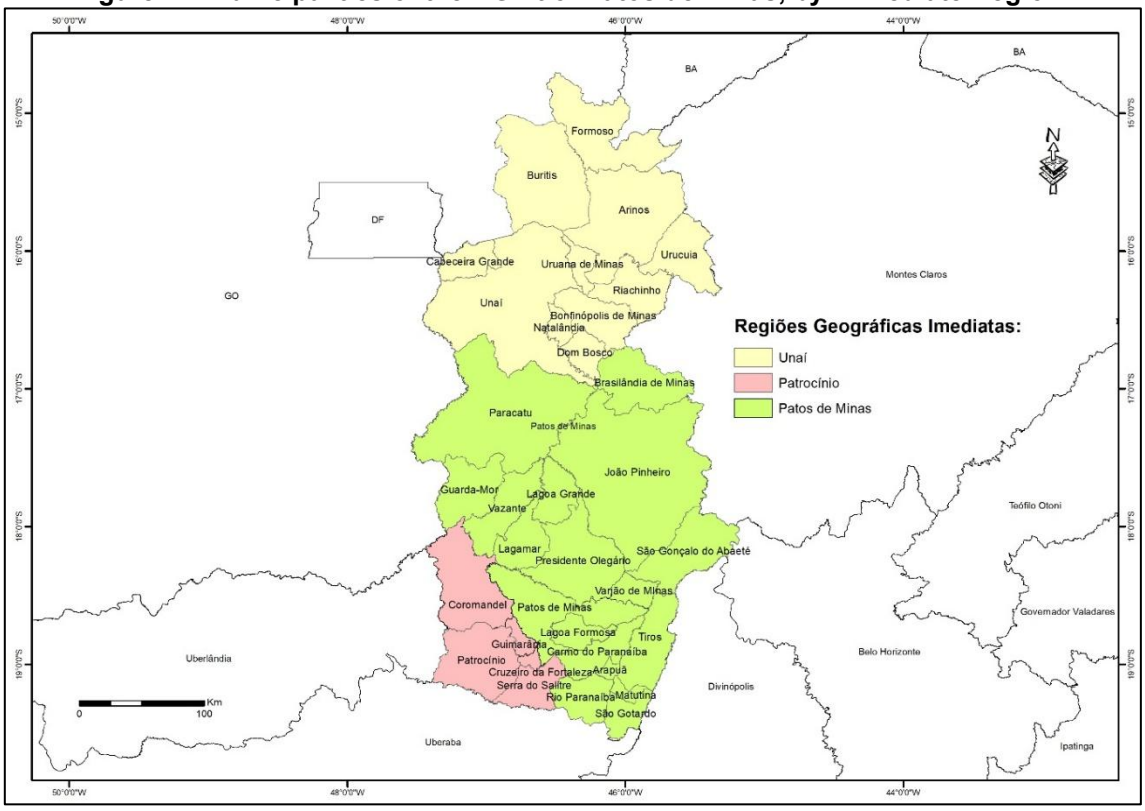
Figure 2 – Municipalities of the RGInt of Patos de Minas, by Immediate Region.



Source: IBGE, 2017. Org: SOARES, I. L.O., 2022

The RGInt of Patos de Minas covers a total area of 84,330.35 km², four municipalities stand out with large areas: João Pinheiro (10,727.097 km²), Unaí (8,445.432 km²) and Paracatu (8,231.029 km²) and Buritis (5,225.186 km²), but the municipalities had a reduced number of inhabitants, according to the 2010 Demographic Census and the 2021 estimates (IBGE, 2010, 2021). Of the 34 municipalities, only Patos de Minas had a population of more than 100 thousand inhabitants. The 2021 estimates also point to a small increase in relation to the 2010 census data, in some municipalities there was a reduction in the population (Table 1).

Table 1 – Population of the RGInt of Patos de Minas, 2010 and 2021.

Geographic Regions Immediate	Municipalities	Population 2010	Population 2021 (estimates)
Patos de Minas	Patos de Minas	138.710	154.641
	Paracatu	84.718	94.539
	João Pinheiro	45.260	47.990
	Gotthard	31.819	36.084
	Carmo do Paranaíba	29.735	30.339
	Ebb	19.723	20.692
	President Olegário	18.577	19.680
	Lagoa Formosa	17.161	18.168
	Brasilândia de Minas	14.226	16.950
	Paranaíba River	12.356	11.885

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	Lagoa Grande	8.631	9.681
	Lagamar	7.600	7.588
	Shots	6.906	6.369
	Guarda-mor	6.565	6.558
	São Gonçalo do Abaeté	6.264	8.527
	Varjão de Minas	6.054	7.235
	Morning	3.761	3.733
	Arapuá	2.775	2.836
Unaí	Unaí	77.565	85.461
	Buritis	22.737	25.179
	Urucuia	13.604	17.470
	Arinos	17.674	17.850
	Beautiful	8.177	9.810
	Riachinho	8.007	8.132
	Large Headboard	6.453	7.025
	Bonfinópolis de Minas	5.865	5.397
	Don Bosco	3.814	3.635
	Natalandia	3.280	3.306
	Uruana de Minas	3.235	3.256
Sponsorship	Sponsorship	82.471	92.116
	Coromandel	27.547	27.958
	Serra do Salitre	10.549	11.750
	Guimarânia	7.265	8.168
	Fortress Cruise	3.934	3.651
Total		772.839	823.838

Source: IBGE, 2010 Census and 2021 Estimates. Org: SOARES, I. L.O., 2022

Despite the low population density, the RGInt of Patos de Minas demands a significant amount of water, due to the economic activities developed, especially for irrigation and other productive arrangements. The third bean harvest in the region, for example, basically depends on irrigation, as the calendar coincides with dry periods in the cultivated regions, as ANA (2021, p.14) points out: "[...] in the West of Bahia, in Mato Grosso and in the region of the Federal District and neighboring municipalities in Goiás and Minas Gerais (region of Cristalina-GO and Unaí-MG)".

Thus, water resources play an essential role in the cultivation of food in rural areas and in its processing. The productive arrangements of the municipalities of the RGInt of Patos de Minas are constantly growing, even with the coronavirus pandemic (Corona Virus Disease 19 (COVID-19), SARS-CoV-2, as pointed out by FJP (2021, p.01):

> In 2020, state exports registered a growth of 4.3%. That same year, RGInt's exports from Patos de Minas grew 27.4%, driven by the advance in gold and soybean exports. The share in Minas Gerais exports corresponded to 7.4% of the total, higher than the share recorded in 2019 (5.9%) and the highest value recorded in the period from 2010 to 2020. During this period, RGInt's share jumped from 3% in 2010 to 7.4% in 2020. In 2010, the share of soybean exports was less than 6%; in 2020, it approached 20%, contributing to RGInt's share gain.

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The growing economic dynamics imply constant pressure for the use and consumption of water, terms differentiated by the IBGE (2020, p. 15-18).

> **[...] water consumption**: Portion of the water withdrawn for use that is not distributed to other economic activities and/or does not return to the environment (for water resources, seas and oceans), because, during use, it was incorporated into products, or consumed by families or livestock. It is calculated as the difference between the total usage and the total provided; Therefore, it can include both losses that occur in evaporation distribution and apparent losses due to clandestine connections or inaccurate measurement.
> **[...] total water use:** Sum of total withdrawal and use of water from other economic activities.

Irrigated agriculture and other smaller areas of productivity, spread throughout the national territory, contribute directly to food security, since food production and access to food are the pillars of food and nutritional sovereignty. According to Brasil (2006, p. 04), in Article 3 of Law No. 11,346/2006:

> Art. 3 Food and nutrition security consists of the realization of everyone's right to regular and permanent access to quality food, in sufficient quantity, without compromising access to other essential needs, based on health-promoting food practices that respect cultural diversity and are environmentally, culturally, economically and socially sustainable.

According to Rodrigues and Domingues (2017), in order to achieve food and nutritional sovereignty by 2050, it is necessary to increase production by 70%. Brazil is one of the countries with a large capacity for agricultural production, since it has cultivable soils, water reserves, favorable solar radiation, including for the production of electricity. In this context, it can be inferred that agribusiness activities have high total water use, but favor a significant return to the environment and food sovereignty.

As Montoya and Finamore (2019, p.10) point out:

> [...] Brazilian agribusiness in the international market holds the status of a major food supplier, it can be inferred that, through the exports of agricultural and agro-industrial products, it is also a major exporter of water to the world economy.

In irrigated agriculture there is a high dependence on quality energy and water demand, and rainfall regimes and the maintenance of recharge areas, care for cultivated soils, investment in renewable energy production, among other strategies that directly or indirectly impact productivity, are essential.

> Irrigated agriculture is the main alternative for increasing food production without expanding the arable area. The diversity of crops, productivity, production stability,

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> efficient use of water, and increase in the number of annual harvests are positive factors for food security and quality of life in the face of growing demands for food, fiber, and renewable energy (GUIMARÃES, LANDAU, 2022, p. 14).

In the municipalities of the RGInt of Patos de Minas, there are several hectares of irrigated agriculture with the use of center pivots and other technologies that contribute to the economic and social development of the region.

> Irrigated agriculture induces, directly or indirectly, a greater contribution of techniques, technologies, innovations, information, knowledge with capacity development, which contributes to the intensification of agricultural practices with gradual insertions of practices and management associated with the concepts of sustainable development. In this way, the use of irrigation brings an increase in crop productivity and social return, as well as financial return for the countryside, including improved respect for ecosystems. In addition, it can establish new opportunities for better qualified jobs, both in the production unit and outside it, as well as and especially in the field of agribusiness, improving the income of rural communities and their quality of life (RODRIGUES; DOMINGUES, 2017, pp.26-27).

In the RGInt of Patos de Minas, the modernization of field activities has had a positive impact on the growth of the Gross Domestic Product (GDP) of some municipalities, which exceed the state average (FJP, 2021).

WATER RESOURCES OF THE INTERMEDIATE REGION PATOS DE MINAS

For a better understanding of the water resources of the RGInt of Patos de Minas, it is important to present the context of the Hydrographic Regions of Brazil. In Brazil there are 12 Hydrographic Regions (Figure 3), formed by several hydrographic basins that are close to each other with environmental, social and economic similarities.

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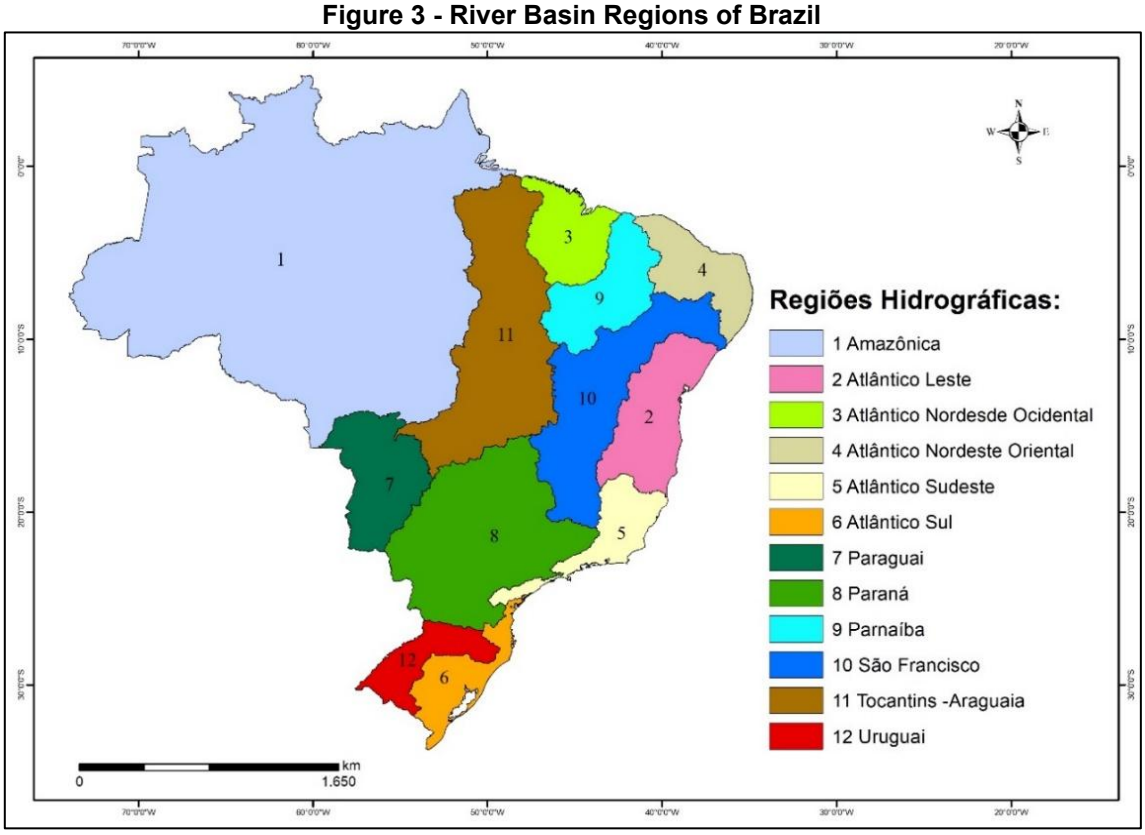
Figure 3 - River Basin Regions of Brazil



Source: ANA, 2021. Org: SOARES, I. L.O., 2022

The hydrographic network represents the set of interconnected basins that drain areas of cities and countryside. The elements that make up a hydrographic basin are integrated, so it is not enough to take care of only the main river, because all streams, streams, rivers, recharge areas are fundamental in the water system. In the territory of Minas Gerais, rivers run through the Hydrographic Regions: São Francisco, Paraná, East Atlantic and Southeast Atlantic. The municipalities of the RGInt of Patos de Minas are inserted in the São Francisco Hydrographic Region and Paraná Hydrographic Region.

The municipalities of the RGInt of Patos de Minas are inserted in the hydrographic basins of the Urucuia and Paracatu rivers (São Francisco Hydrographic Region), in the basins of the Upper Paranaíba River and the Araguari River (Paraná Hydrographic Region), other municipalities are part of these basins. The hydrographic basins of the RGInt of Patos de Minas, presented a natural vegetation base species of the cerrado, however, the largest area has already been decharacterized by urban occupation and agribusiness activities.

The Paracatu River basin is the largest in extension in the RGInt of Patos de Minas, comprising 16 municipalities, with the exception of the municipality of Santa Fé de Minas, which is not part of the RGInt of Patos de Minas. The Urucuia river basin is the second in

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territorial extension of the RGInt of Patos de Minas, encompasses 12 municipalities, four of which are not part of the aforementioned RGInt. The hydrographic basin of the Upper Paranaíba River is the third in extension of the RGInt of Patos de Minas, covers 28 municipalities, but 12 of them do not belong to the RGInt of Patos de Minas. The hydrographic basin of the Araguari River is the fourth in territorial extension, involving 20 municipalities, but only three municipalities are in the RGInt of Patos de Minas (Chart 1).

Table 1 - Hydrographic basins of the municipalities of the RGInt of Patos de Minas

Basins/Areas	Municipalities covered by the basins	Municipalities that are not part of the RGInt of Patos de Minas in the basins
Paracatu 41,371.71 km² - 17.64% of the territory of the São Francisco River basin	Bonfinópolis de Minas, Brasilândia de Minas, Buritizeiro, Cabeceira Grande, Dom Bosco, Guarda-Mor, João Pinheiro, Lagamar, Lagoa Grande, Natalândia, Paracatu, Patos de Minas, Presidente Olegário, Santa Fé de Minas, Unaí and Vazante.	Santa Fe de Minas
Urucuia 25,032.53 km² - 10.67% of the territory of the São Francisco River basin	Arinos, Bonfinópolis de Minas, Buritis, Chapada Gaúcha, Formoso, Pintópolis, Riachinho, Santa Fé de Minas, São Romão, Unaí, Uruana de Minas and Urucuia.	Chapada Gaúcha, Pintópolis, Santa Fé de Minas and São Romão.
Alto Paranaíba 22,244 km² - 31.49% of the territory of the Paranaíba River basin	Abadia dos Dourados, Araguari, Araporã, Carmo do Paranaíba, Cascalho Rico, Coromandel, Cruzeiro da Fortaleza, Douradoquara, Estrela do Sul, Grupiara, Guarda-Mor, Guimarânia, Iraí de Minas, Lagamar, Lagoa Formosa, Monte Carmelo, Nova Ponte, Paracatu, Patos de Minas, Patrocínio, Presidente Olegário, Rio Paranaíba, Romaria, Serra do Salitre, Tupaciguara, Unaí.	Abadia dos Dourados, Araguari, Araporã, Cascalho Rico, Douradoquara, Estrela do Sul, Grupiara, Iraí de Minas, Monte Carmelo, Nova Ponte, Romaria and Tupaciguara.
Araguari River 21,500 km² - 30.44% of the territory of the Paranaíba River basin	Araguari, Araxá, Campos Altos, Ibiá, Indianópolis, Iraí de Minas, Nova Ponte, Patrocínio, Pedrinópolis, Perdizes, Pratinha, Rio Paranaíba, Sacramento, Santa Juliana, São Roque de Minas, Serra do Salitre, Tapira, Tupaciguara, Uberaba, Uberlândia.	Araguari, Araxá, Campos Altos, Ibiá, Indianópolis, Iraí de Minas, Nova Ponte, Pedrinópolis, Perdizes, Pratinha, Sacramento, Santa Juliana, São Roque de Minas, Tapira, Tupaciguara, Uberaba, Uberlândia.

Source: IGAM, 2022. Org.: SOARES, I. L.O., 2022.

There are several river courses that run through the municipalities of the RGInt of Patos de Minas, with use by small, medium and large producers, which implies planning actions to avoid water insecurity. In the Immediate Region of Unaí, the Urucuia, Bezerra, Piratinga, Preto, São Domingos rivers can be highlighted; the Salobro, Roncador and Santa Cruz streams, among others. The Immediate Region of Patrocínio is drained by the Paranaíba, Araguari, Dourados, Preto, Santo Inácio, Quebra de Anzol and Dourados rivers. The Immediate Region of Patos de Minas has many watercourses, namely, rivers:

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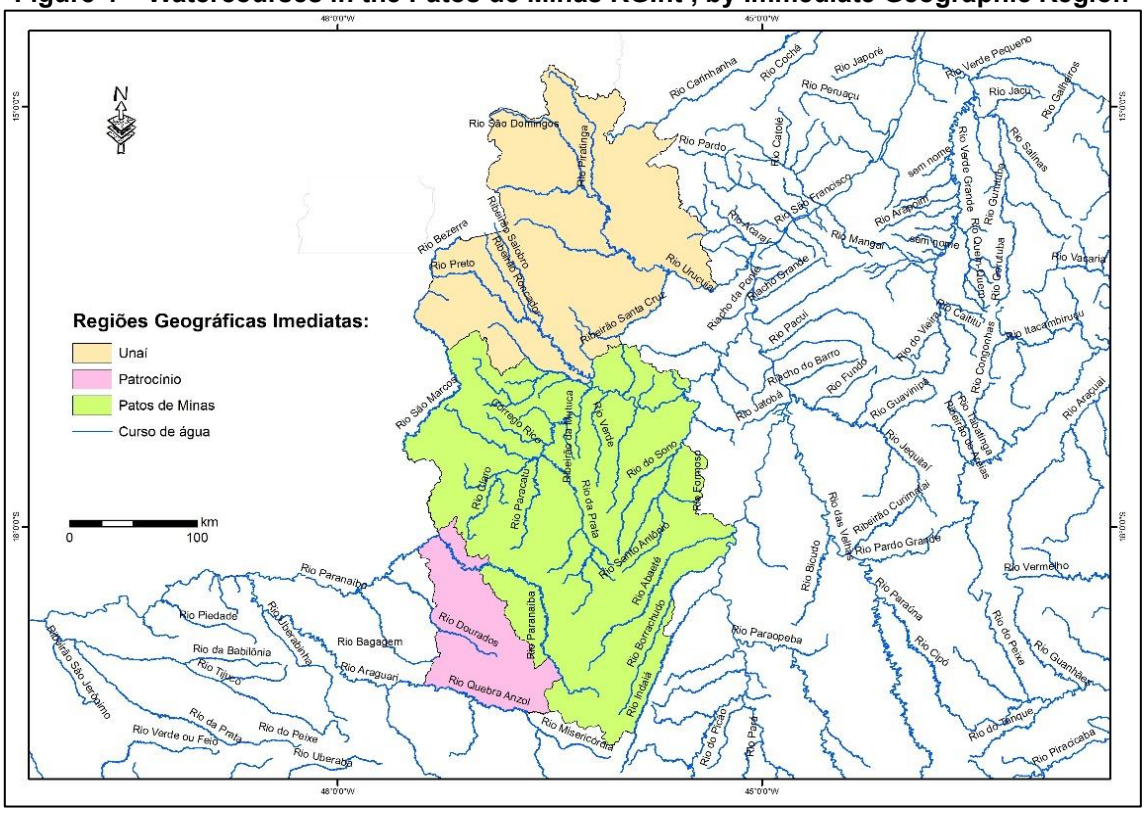
Paranaíba, Paracatu, Claro, Santo Antônio, Abaeté, Borrachudo, Indaiá, do Sono, Verde, São Marcos, Formoso; Córrego Rico, Ribeirão da Mutuca, among others (Figure 4).

The aforementioned RGInt also houses part of the center pivot poles in Brazil, where the production of grains for export stands out. According to ANA (2021, p.92):

> The 15 national centers of *central pivots* are predominantly dedicated to the production of grains (soybeans, corn, beans, cotton, etc.), most of them in the Cerrado, but also in transition regions between the Cerrado and the Amazon (Alto Teles Pires) and between the Atlantic Forest and the Pampa (Uruguay and Alto Jacuí), in addition to Mucugê-Ibicoara in the Caatinga. The centers are distributed in seven Federation Units (BA, DF, GO, MT, MG, SP and RS). In the Paracatu/Entre Ribeiros (MG) pole, the irrigation of sugarcane by pivots and other sprinkling methods is also relevant [...]

Figure 4 – Watercourses in the Patos de Minas RGInt , by Immediate Geographic Region



Source: IGAM, 2022. Org: SOARES, I. L.O., 2022

In the Paracatu/Entre Ribeiros pole, 461 billion liters/year, the main irrigating municipality is Paracatu, but there are other municipalities in the RGInt of Patos de Minas that are part of the São Marcos pole 361 billion liters/year, whose main irrigating municipalities are Unaí and Paracatu in Minas Gerais (in addition to Cristalina in Goiás). The Alto Araguari / Paranaíba pole, 299 billion liters/year, which has as its main irrigating municipalities: Patrocínio and Rio Paranaíba; in addition to Uberaba, Perdizes, Santa Juliana and Indianópolis, which are not part of the RGInt of Patos de Minas (ANA, 2021).

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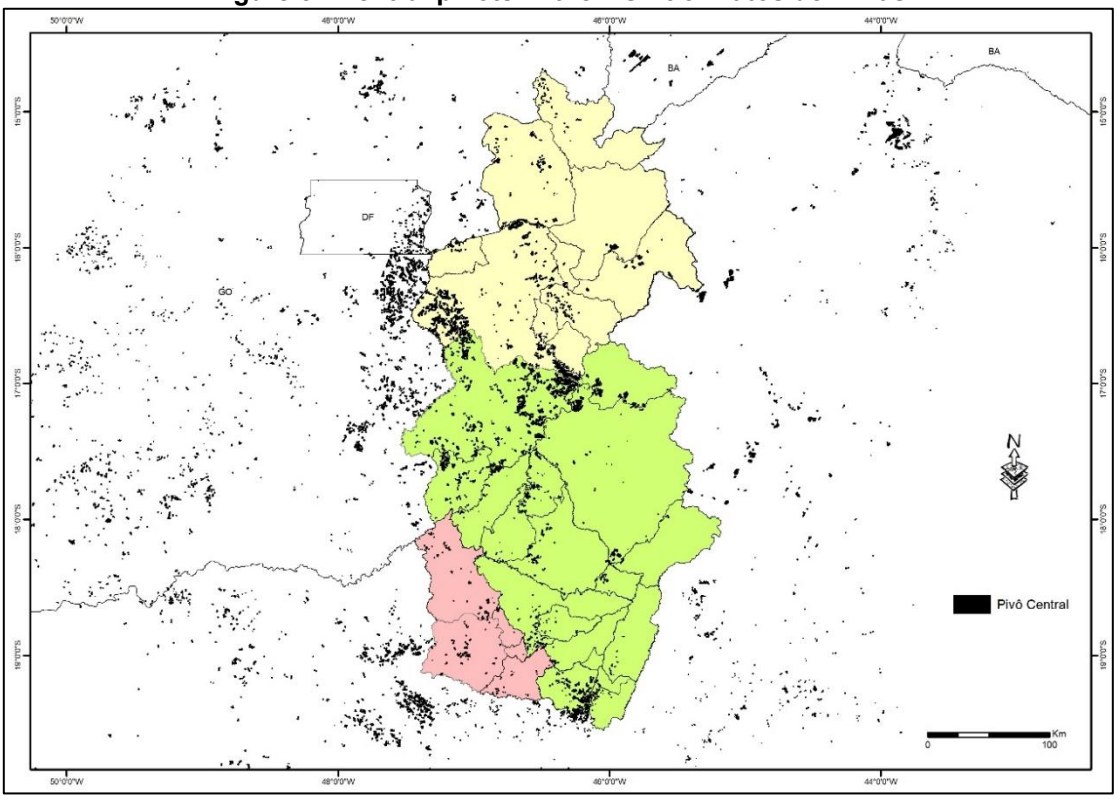
In surface irrigation, the water...

> [...] It is arranged on the surface of the soil and its level is controlled for the use of plants. In the underground (or subsurface) method, water is applied below the surface of the soil, forming or controlling the water table, in the region where it can be used by the roots of the plants. In sprinkler irrigation, water is applied under pressure above the ground, through sprinklers or holes, in the form of an artificial rain. The localized method (or microirrigation) consists of application in a very limited area, using small volumes of water, under low pressure, with high frequency. There are different systems for each of these methods, such as the flood system in surface irrigation; the center pivot system in sprinkler irrigation; and the drip system that occurs in the underground and localized methods (ANA, 2021, p. 11).

The distribution of the center pivots in the RGInt of Patos de Minas demonstrates the potential of irrigation (Figure 5).

Figure 5 - Central pivots in the RGInt of Patos de Minas



Source: ANA, 2019. Org: SOARES, I. L.O., 2022

According to Guimarães, Landau (2020, p.24): "Among the twenty municipalities with the largest area potentially irrigated by the installed center pivot equipment, there are five located in the state of Minas Gerais (Paracatu, Unaí, Rio Paranaíba, João Pinheiro, Perdizes) [...]". Of the five, only Perdizes is not part of the RGInt of Patos de Minas. The municipality of Paracatu, in the RGInt of Patos de Minas, stood out in irrigated area per

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hectare (ha) and in number of pivots, only Arapuá did not present irrigation with center pivot (Table 2).

The municipalities of Paracatu and Unaí occupied the first and second place, in the national context, with the largest area equipped with center pivots. In Minas Gerais, the total irrigated area in 2019 was 478,588 (ha) and 8,115 center pivots, therefore, the participation of the municipalities of the RGInt of Patos de Minas was extremely significant, as 272,546 (ha) of irrigated area and 4,375 center pivots were installed (ANA, 2022).

Table 2 - Municipalities of the RGInt of Patos de Minas with area irrigated by center pivots in 2019.

Geographic Regions Immediate	Municipalities	Area (ha)	No. of center pivots
Patos de Minas	Paracatu	72.726	1.177
	João Pinheiro	15.843	211
	Paranaíba River	15.326	342
	Guarda-mor	11.836	282
	Brasilândia de Minas	8.218	96
	Lagoa Grande	7.688	170
	Ebb	5.101	80
	Patos de Minas	5.064	132
	President Olegário	4.738	93
	Lagamar	2.391	63
	Gotthard	2.197	71
	Varjão de Minas	1.406	26
	Carmo do Paranaíba	1.392	28
	Shots	781	26
	São Gonçalo do Abaeté	766	12
	Lagoa Formosa	683	17
	Morning	288	07
	Arapuá	----	-----
Unaí	Unaí	66.980	819
	Buritis	10.254	115
	Bonfinópolis de Minas	7.627	92
	Large Headboard	6.129	90
	Beautiful	3.183	59
	Urucuia	2.724	34
	Arinos	2.323	22
	Don Bosco	1.579	31
	Natalandia	403	07
	Uruana de Minas	895	13
	Riachinho	187	03
Sponsorship	Sponsorship	5.216	98
	Coromandel	5.886	96
	Serra do Salitre	2.378	55
	Fortress Cruise	177	05
	Guimarânia	161	03
Total		272.546	4.375

Source: ANA, 2022. Org: SOARES, I. L.O., 2022

When comparing data from the 2017 survey with that of 2019, growth in the irrigated area and the number of center pivots was identified in the municipalities of the RGInt of Patos de Minas, with the exception of Riachinho and Urucuia. In 2017, in the municipality of

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Riachinho, an area of 478 (ha) and 08 central pivots were registered; in Urucuia, the area was 3,285 (ha) and 40 center pivots (ANA, 2022).

The water potential of municipalities is used in the agribusiness production chain, with impressive results, as shown by data from FJP (2021, p.01):

> In 2020, state exports registered a growth of 4.3%. That same year, RGInt's exports from Patos de Minas grew 27.4%, driven by the advance in gold and soybean exports. The share in Minas Gerais exports corresponded to 7.4% of the total, higher than the share recorded in 2019 (5.9%) and the highest value recorded in the period from 2010 to 2020. During this period, RGInt's share jumped from 3% in 2010 to 7.4% in 2020. In 2010, the share of soybean exports was less than 6%; in 2020, it approached 20%, contributing to RGInt's share gain.

The municipalities stand out in the production of grains (coffee, corn, beans and soybeans); cattle/dairy farming and dairy manufacturing; forest production; cultivation of sugarcane and sugar production, manufacture of animal feed and wood products, planting pineapple, tomato, among others. However, they are...

> “[...] growing tendencies of conflict over the use of water between the irrigators themselves, with rural producers, the urban sector, the industrial sector and the electricity sector. The trend of concentration of irrigation poles tends to aggravate conflicts" (GUIMARÃES, LANDAU, 2022, p. 14).

In Minas Gerais, the issuance of the Conflict Area Declaration (DAC) is the responsibility of the IGAM. In the state there are 36 River Basin Committees (CBHs), but despite their performance, there are conflicts over water resources.

> According to article 6 of Decree No. 47,705, of September 4, 2019, the occurrence of conflict over the use of surface water resources occurs when there is a situation of water unavailability measured by the water balance of granted flows, in which the demand for the use of water resources in a hydrographic portion is higher than the grantable flow. In 2020, Igam published Ordinance No. 26, OF JUNE 05, 2020, which establishes the Local Management Commission – CGL – within the scope of the process of collective granting of the right to use surface water resources in areas declared to be in conflict over the use of water resources (IGAM, 2022 online).

Costa et al. (2021), carried out a historical survey of conflicts in the Paracatu River basin, where they identified DAC since 2006, in the course of the Entre Ribeiros Stream, in addition to the Boa Esperança Stream (2006), Engenho Velho Stream (2008) and Escuro River (2018), all inserted in the municipality of Paracatu and the Caatinga River (2015), located in João Pinheiro.

In 2020, 65 DACs were identified in Minas Gerais, 24 of which in the RGInt of Patos de Minas. The conflicts were recorded in the municipalities of Paracatu, Formoso, João

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Pinheiro: In Paracatu, there were nine conflicts in: Ribeirão Entre Rios, Córrego do Barreiro, Ribeirão Mundo Novo, Córrego Macaúbas, Rio Escuro, Córrego Boa Esperança, Córrego Engenho Velho and Rio da Batalha (IGAM, 2021).

In the municipality of Unaí there are records of five conflicts, being them over the waters of: Ribeirão da Garapa, Ribeirão da Jiboia, Córrego Bebedouro, Ribeirão das Almas and Ribeirão Santa Cruz. Also in Bonfinópolis de Minas, two conflicts were identified in Ribeirão Santa Cruz and Ribeirão das Almas. In Formoso there were four conflicts in: Rio Piratinga, Rio Ponte Grande, Ribeirão do Pinduca and Córrego dos Poldros). In Patrocínio, three areas of conflict were declared: Rio Dourado, Córrego Bom Jardim and Ribeirão Rangel or Pavões. In the municipality of João Pinheiro, a DAC took place in the Caatinga River (IGAM, 2021).

> Most of the basins with quantitative criticality indicators in Brazil have irrigated agriculture as their main consumptive use. Conflicts occur within the sector (between irrigators) or with other sectors such as urban supply and energy generation. The criticality occurs due to the high demands of irrigation, but also in regions with moderate demands, but with low water availability. With the prospect of increasing the use of water for irrigation by 42% in the 2030 horizon, a growing effort is needed to plan and manage water resources (ANA, 2019, p.45).

Conflicts are not a past problem, on the contrary, they are part of the lives of many producers, regardless of size, in addition to a strong trend for future generations. To avoid conflicts, it is necessary to plan, manage the entire system of the hydrographic basins, innovation strategies and improvements of production systems with sustainable practices, as well as the revitalization of river springs, protection of recharge areas, reuse of water, among other actions that promote socio-environmental balance.

CONCLUSION

It is concluded that the municipalities of the Intermediate Geographic Region of Patos de Minas (RGInt) are inserted in the hydrographic basins of the Urucuia and Paracatu rivers (São Francisco Hydrographic Region), the Upper Paranaíba River basin and the Araguari River (Paraná Hydrographic Region). They have high use of water resources for agriculture irrigated by central pivots, mainly Unaí and Paracatu, municipalities that concentrate the largest irrigated area and concentration of central pivots of the RGInt.

The fact that the RGInt of Patos de Minas is a producer of grains, milk and derivatives, among others, makes it essential to develop sustainable public policies for

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greater and better use of water resources, since there are already conflicts over the use of water, despite high availability and low population density.

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