


**ANALYSIS OF THE HUMAN DEVELOPMENT INDEX BASED ON THE
IMPLEMENTATION OF A PULP MILL IN MATO GROSSO DO SUL**

**ANÁLISE DO ÍNDICE DE DESENVOLVIMENTO HUMANO A PARTIR DA
IMPLANTAÇÃO DE FÁBRICA DE CELULOSE EM MATO GROSSO DO SUL**

**ANÁLISIS DEL ÍNDICE DE DESARROLLO HUMANO A PARTIR DE LA IMPLANTACIÓN
DE UNA FÁBRICA DE PASTA DE PAPEL EN MATO GROSSO DO SUL**

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ABSTRACT

The state of Mato Grosso do Sul stands out in the pulp and paper sector. This article analyzes the impact of the pulp industry on the Human Development Index (HDI) in a small municipality in Mato Grosso do Sul. To this end, a systematic review was conducted following the criteria of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). Of the 178 articles found, 11 articles were selected that showed that to maximize benefits and mitigate risks, there must be integrated planning, with the participation of the community and local authorities, promoting development that respects human beings and the environment. Increasing income and education can increase the HDI, but environmental and social challenges must be managed effectively to ensure that development is sustainable. There is a need for sustainable practices, because if the industry compromises natural resources, it can have long-term impacts on health and the local economy, negatively affecting the HDI.

Keywords: Social Determinants of Health. Human Development Index. Pulp and Paper Industry. Regional Planning. Social Impact Indicator.

RESUMO

O estado de Mato Grosso do Sul se destaca no setor de celulose e papel. Este artigo analisa o impacto das indústrias de celulose sobre o Índice de Desenvolvimento Humano (IDH) em um pequeno município de Mato Grosso do Sul. Para isto, foi conduzida uma revisão sistemática seguindo os critérios do Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). Dos 178 artigos encontrados, foram selecionados 11 artigos que evidenciaram que para maximizar os benefícios e mitigar os riscos deve haver um planejamento integrado, com a participação da comunidade e das autoridades locais, promovendo um desenvolvimento que respeite o ser humano e o meio ambiente. O aumento da renda e da educação pode elevar o IDH, mas os desafios ambientais e sociais devem ser geridos de forma eficaz para garantir que o desenvolvimento seja sustentável. Há necessidade de práticas sustentáveis, pois se a indústria comprometer os recursos naturais, pode ter impactos a longo prazo na saúde e na economia local, afetando negativamente o IDH.

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Palavras-chave: Determinantes Sociais da Saúde. Índice de Desenvolvimento Humano. Indústria de Papel e Celulose. Planejamento Regional. Indicador Impacto Social.

RESUMEN

El estado de Mato Grosso do Sul se destaca en el sector de pulpa y papel. Este artículo analiza el impacto de las industrias de celulosa en el Índice de Desarrollo Humano (IDH) de un pequeño municipio de Mato Grosso do Sul. Para ello, se realizó una revisión sistemática siguiendo los criterios de los Elementos de Informe Preferidos para Revisiones Sistemáticas y Metaanálisis (PRISMA). De los 178 artículos encontrados, se seleccionaron 11 artículos que demostraron que para maximizar beneficios y mitigar riesgos debe existir una planificación integrada, con participación de la comunidad y autoridades locales, promoviendo un desarrollo respetuoso con el ser humano y el medio ambiente. El aumento de los ingresos y la educación pueden elevar el IDH, pero los desafíos ambientales y sociales deben gestionarse eficazmente para garantizar que el desarrollo sea sostenible. Es necesario adoptar prácticas sostenibles, porque si la industria compromete los recursos naturales, puede tener impactos a largo plazo en la salud y la economía local, afectando negativamente el IDH.

Palabras clave: Determinantes Sociales de la Salud. Índice de Desarrollo Humano. Industria de Pulpa y Papel. Planificación Regional. Indicador de Impacto Social.

1 INTRODUCTION

Industrialization contributes to economic growth by increasing productive capacity, job creation, innovation, and the optimal use of resources. The industrial sector is considered one of the main drivers of Gross Domestic Product (GDP) because it provides goods and services (exports), income, and employment opportunities¹.

In this sense, the pulp and paper industry is an expanding productive activity in Brazil, which is considered a world reference in paper production, as it is estimated that the sector contributes with 46.5% of the national gross domestic product. The state of Mato Grosso do Sul (MS) has stood out in this sector, as there is an interest in the expansion of these activities with the objective of providing a significant economic boost² and consolidating Mato Grosso do Sul as the "Pulp Valley" (Figure 1), contemplating the municipalities of Inocência, Ribas do Rio Pardo and Três Lagoas, which have a production capacity forecast of exceeding 10 million tons of pulp per year³.

The main economic bias in the municipality of Ribas do Rio Pardo is the agricultural sector, either from cattle raising or from the charcoal factories that were installed there due to the large amount of eucalyptus planting, a practice fostered during the military government through the granting of credits, tax exemptions, among others^{4,5}. The installation of pulp mills in the interior of Mato Grosso do Sul represents a historic opportunity for economic and social growth for cities, but it also requires careful planning so that environmental and social impacts are mitigated^{2,6}.

Recent studies show that large industries can have several impacts on health indicators in small municipalities. These can be both positive and negative and vary depending on several factors, including the type of industry, environmental management practices, public health policies, and socioeconomic conditions in the region⁷⁻⁹. With regard to the pulp industry, it is possible to mention some specific aspects, such as: air pollution, exposure to respiratory and skin diseases, groundwater, soil pollution, social, economic, and political impacts^{1,6}.

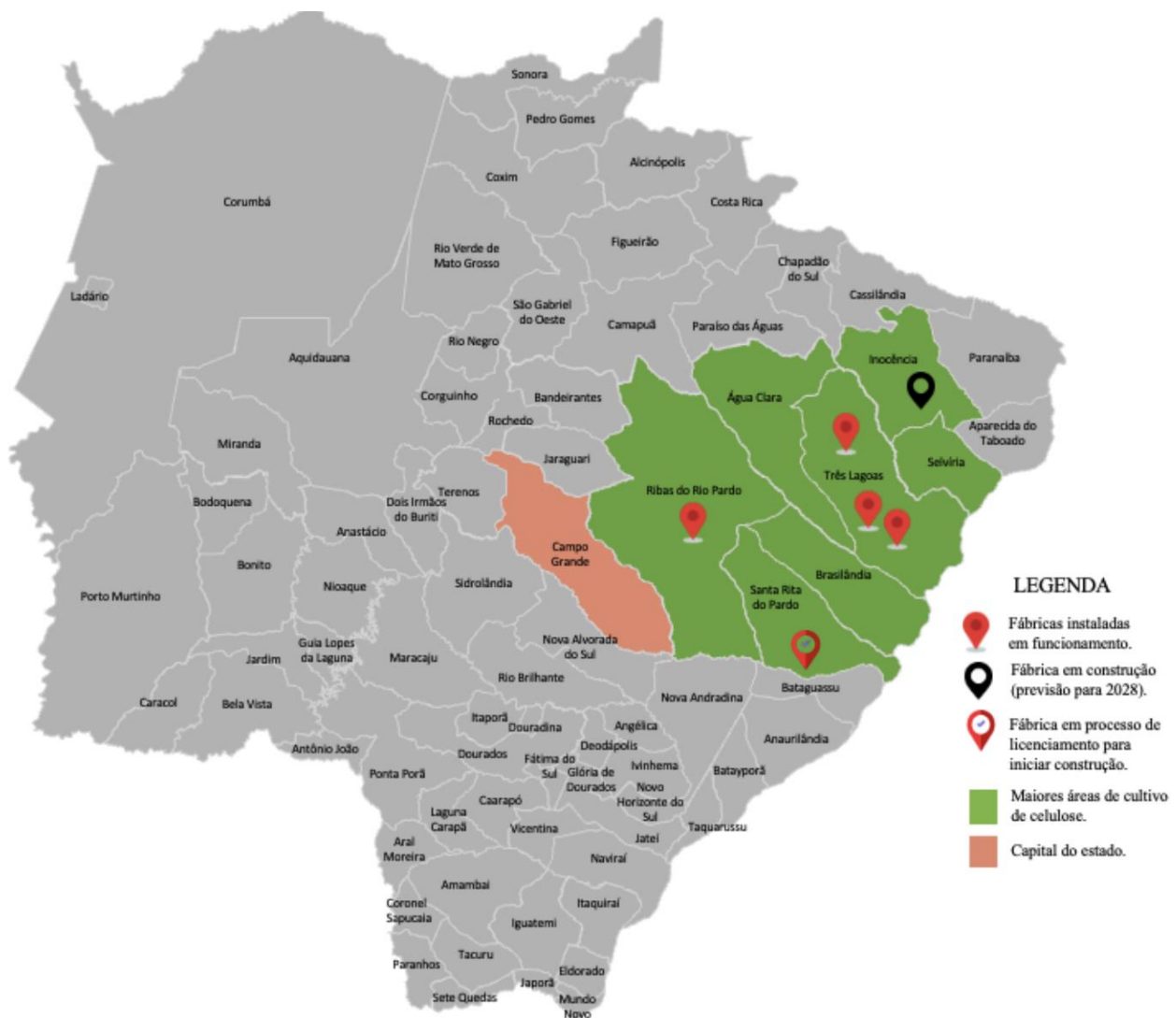
However, few researchers have systematically studied the joint influence of the growth of cities and corporations on the health of populations¹⁰. Access to contemporary technology encourages the development of clean industries¹¹. As industrialization increases, resource depletion resurfaces and negatively affects the well-being of the population⁷.

In general, the impact of large industries on human development indices in small municipalities is complex and multifaceted. It is essential that there is a balance between industrial development and the preservation of health and the environment¹².

In this sense, it is necessary to carry out further investigations on the impacts on the human development indices (HDI) of these municipalities, in view of the scarcity of publications on the subject that is related to sustainable development. Thus, this article seeks to analyze the impact of large pulp industries on the HDI in a small municipality in Mato Grosso do Sul.

Figure 1

Map of the municipalities of the state of Mato Grosso do Sul with emphasis on the "Pulp Valley" area



Source: The authors.

2 MATERIAL AND METHODS

This systematic review was conducted following the recommendations and specific criteria of the *Preferred Reporting Items for Systematic Reviews and Meta-Analysis* (PRISMA). The research problem is precisely in the attempt to answer what are the multifaceted effects of large industries on the HDI in small municipalities, and how can integrated policies be implemented to balance industrial development with the protection of the health of the local population? For this, the eligibility criterion used to define the research question was: Population (adults), Intervention (municipality with the implementation of a pulp mill), Comparison (implementation of mills in other small municipalities), Outcome (economic growth, local development, improvements in education (IDEB) and health: increase in life expectancy, decrease in mortality and chronic and communicable diseases), Types of study (observational - analytical, systematic reviews).

Studies published in English, Portuguese, or Spanish between 2009 and 2024 (September), indexed in the electronic databases: Pubmed, SciELO, Lilacs, Cochrane, and VHL, were examined. The terms adopted are part of the health descriptors (DeCS), and the combined and/or individual form was used to search for the articles: industrialization, pulp and paper industry, industrial development, regional planning, social determinants of health, and social impact indicators.

Cross-sectional studies that relate socioeconomic variables among adults (18 to 60 years) of both sexes were eligible for inclusion. Exclusion criteria will be considered: case studies, cohort studies, randomized and non-randomized studies, pilot studies; studies in languages other than English, Spanish and Portuguese, studies with children and adolescents.

2.1 SELECTION OF STUDIES

The search process included an evaluation hierarchy in which studies will be peer-reviewed, first by the title of the journal (and duplicates removed), second by the abstract, and third by the full review of the article when the full text was included or excluded based on the inclusion and exclusion criteria.

2.2 DATA EXTRACTION

Data extraction occurred independently, using standardized forms, which included information on author and year of publication, participants (number of individuals, age, and

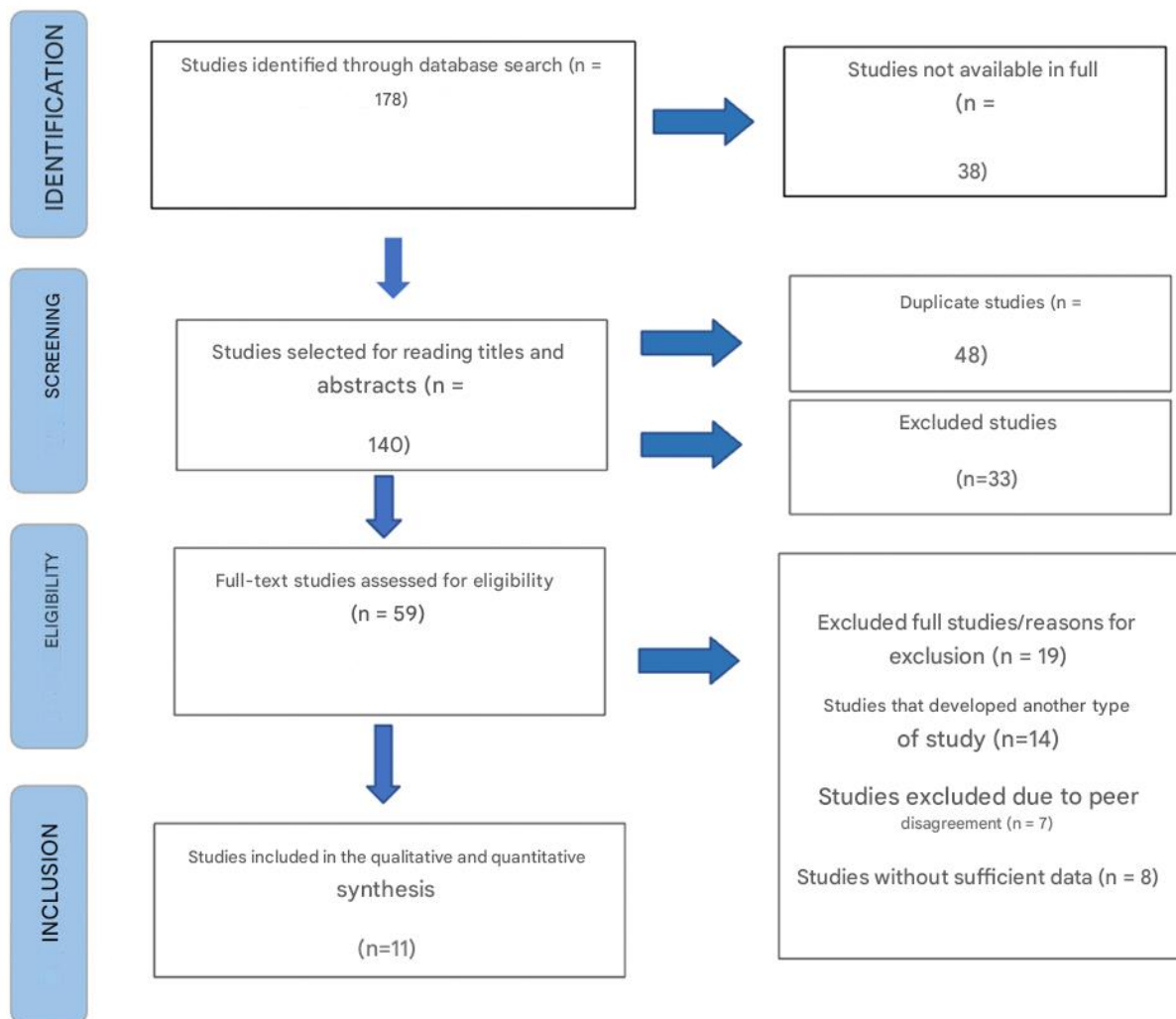
gender), study design, evaluation scale, study duration, and intervention results. In the event of inconsistency, the original documents were recovered and investigated together for consensual definition. Outcomes of interest included: economic growth, local development, improvements in education and health, and a drop in the crime rate.

3 RESULTS AND DISCUSSION RESULTS

A total of 178 articles and documents were identified in the present review, based on the keywords chosen. Excluding duplicate studies and of these, 59 were selected for full reading of the text and 11 were included in the study (Figure 2) as organized in tables 1 and 2.

Figure 2

Flowchart of the systematic review of the literature



Source: The authors.

Table 1

Selected articles by year of publication filtered between the years 2017 to 2023

Author/ year	Title	Goal	Methods	Conclusion
Leal et al, 2023	Agroforestry project: advancement of the pulp and paper industry in Brazil from Suzano and the specialization of work in the pulp production chain in Imperatriz/MA.	To show how the advancement of the pulp and paper industry influenced the reorganization, specialization and orientation of the region's workforce to serve the production chain.	Review in conjunction with the field research used secondary data on changes in local employment and professional qualifications resulting from the implementation of Suzano.	The advancement of the industry influences the organization of the workforce to respond to the functioning of the pulp production chain, it is the most evident integration in the labor market.
Vinhas Medeiros et al, 2021	Eucalyptus cultivation in the extreme south region of the state of Bahia: land use and socioeconomic analyses.	Monitoring of land use, social and economic indicators of the pulp and paper production municipalities in the region.	They were used to generate maps and secondary socioeconomic data (IBGE). The analysis of these parameters allowed us to see the socioeconomic dynamics in the region.	The eucalyptus crop triggered structural and conjunctural transformations. The perspective is that the area planted with extensive monocultures will continue to increase.
Souza and Pietrafesa , 2019	The new industry in the southwest of Maranhão: impacts socioeconomic in the city of Imperatriz – MA.	Analyze the socioeconomic impacts of implementation of a pulp and paper industry in the city of Imperatriz, between 2008 and 2016.	Bibliographic review in books, specialized technical publications and journal articles. For the analysis of the results, variables such as GDP and FMDI were verified.	It was concluded that the arrival of the factory contributed to the growth of the economy, by increasing the GDP, in addition to improvements in education and health verified in the IFDM analysis.
Perpetua, 2019	Territorial looting, precariousness of work and degradation of the working subject: reflections from the production of pulp in Brazil.	Multiscale analysis of the expansion of monoculture and pulp production in three different Brazilian regions.	The research combined quantitative and qualitative procedures, investigating the case of three regions: Porto Seguro (BA), Três Lagoas (MS) and Imperatriz (MA).	The transformation of countries into major world producers and exporters of pulp generates less value addition and greater socio-environmental impacts.
Lopes et al, 2017	Pulp captivity: consequences of capitalist appropriation in the region of Três Lagoas/MS.	To identify socio-environmental conflicts due to the implementation of pulp-paper industries in Três Lagoas, between 2009 and 2015.	Inductive method, application of questionnaires in order to compose a spectrum of what subjects could present about socio-environmental conflicts.	The operation of the pulp industries in Três Lagoas triggered a monocultural model that began to exercise the monopoly of investments in the region, from the Mato Grosso do Sul Pocket.

Source: The author.

Table 2

Selected articles by year of publication filtered between the years 2009 and 2013

Author/ year	Title	Goal	Methods	Conclusion
Carvalho, 2013	Social, economic and environmental determinants of health.	Improve the health situation and reduce inequities, considering the social determinants: population and health profile.	Scoping review and secondary data analysis.	It considered health as a beneficiary and as a key indicator of development that includes the material, social, psychological, educational and environmental dimensions.
Kudlavicz, 2011	The impacts of eucalyptus monoculture plantations in the micro-region of Três Lagoas/MS.	To analyze the impacts of the expansion of eucalyptus plantations and the establishment of a pulp and paper mill belonging to the company FIBRIA in Três Lagoas.	Data collected in a literature review and fieldwork, where emphasis was given to the statements of subjects who feel the consequences of socio-environmental and economic changes in the region on a daily basis.	Monoculture has led to the imbalance of fauna and flora, and the spectacularization of land tenure. There are social groups, from the countryside and the city, that benefit from this development model.
Vilela, 2011	Environmental Challenges of the Expansion of Eucalyptus Plantations in the Cerrado - Três Lagoas/ MS Brazil.	Assess the risks of alterations and losses in natural systems, due to the advance of planting areas recorded in Três Lagoas/ MS.	Summary of the I Symposium on the formation of the pulp-paper complex in Mato Grosso do Sul: limits and perspectives"	Monoculture brought changes in land occupation due to the extension of planted areas, the mechanization of crops and the intensive use of fertilizers and pesticides.
Andrade, 2010a	Pulp and paper mills: a study on the environmental, social and educational consequences in the city of Três Lagoas/MS.	Analyze the impacts caused by the installation of two factories, understand their participation in the Environmental Education Program.	Study analyzing newspapers, websites and interviews with those responsible for the Environmental Education Program.	In the social aspect, the quality of life of the local population was compromised. In education, it can be seen that the PEA did not generate significant changes.
Andrade, 2010b	Pulp and paper mill: impacts and perspectives on the development of the municipality of Três Lagoas/MS.	Analyze the concrete impacts that mark the history of factories in the municipality until 2010.	Study that was limited to the analysis of two large multinationals pulp and paper manufacturers in the city of Três Lagoas/MS.	The environmental impacts indicate that the municipality is susceptible to impacts with irreversible consequences, which have extended far beyond the municipalities.
Almeida, 2009	Socioeconomic reorganization in the extreme south of Bahia resulting from the	To analyze the socioeconomic reorganization resulting from the insertion of	Diagnosis of the main social and economic transformations through bibliographic survey and data from	The insertion of eucalyptus increased Bahia's participation in the country's exports, boosting the state's

introduction of eucalyptus culture.	eucalyptus in the extreme south of Bahia.	the IBGE, SEI and UNDP Human Development Atlas.	economy. The GDP of the state and the producing municipalities grew.
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Source: The author.

The studies clarify that the installation of a pulp industry can cause significant changes in the Human Development Index (HDI) of a region. The HDI is a measure that evaluates the social and economic development of a country or municipality, considering factors such as life expectancy, education, and per capita income. From the selected literature, it was possible to organize the multifaceted effects into discussion blocks:

- Increased Income and Employment

One of the most immediate impacts of the installation of a pulp industry is the generation of jobs. The factory creates direct and indirect opportunities, from jobs in the industry itself to functions in related sectors, such as transportation, commerce, and services. Inserted in this aspect, there is an improvement in family income due to job creation, where an increase in family income is expected, which can raise the standard of living and, consequently, the HDI of the region. In addition, the increase in income can stimulate local commerce, generating a positive cycle of economic growth¹²

Second Environmental Impact Study (EIA)/ Environmental Impact Report (RIMA)¹⁴, the implementation of an industrial unit promotes economic development and increased infrastructure in the region. Direct and indirect salaries promote an increase in tax collection, which will allow the association of the government and other agencies with incremental investment in the development of social and economic programs. This process is called the multiplier effect and is based on economic theories^{13,15}.

With the construction of the pulp mill in Ribas do Rio Pardo (MS), around 10 thousand jobs were generated during the construction phase, in addition to another 3 thousand stable jobs after the start of operation in July 2024. This initiative not only increased the supply of labor, but also stimulated the local economy with the movement of workers and their families to the city, contributing to population growth and the expansion of public services and local infrastructure³.

The exponential growth of paper consumption in the world in recent decades is the generator of the new territorial division of labor in the paper industry. In this division, in which the peripheral countries are increasingly inserted as producers of raw materials, China

appears as the major producer of the final product and the central capitalist countries as final consumers¹⁶.

- Education and Training

The presence of a large industry often drives the demand for skilled labor. This can lead to investments in education and professional training. However, what can be seen through the numbers provided by the National Institute of Educational Studies and Research Anísio Teixeira (INEP) on the Basic Education Performance Index (IDEB), which is the calculation that measures the quality of education in Brazil, from 2021 to 2023, there was no significant improvement, maintaining a certain stability, however, 2 years is a short time to evaluate the improvement in basic education in the municipality based on the IDEB^{17,18}.

As part of the plan to improve education for the local population, the factory has its own educational program, which is linked to the long-term goal of increasing the IDEB score by 40% in priority municipalities by the year 2030. To this end, in addition to effective practices of educators in the classroom, the program includes topics such as access to and permanence in school and the guarantee of other rights as well, such as: food security, the eradication of child labor and access to social public policies. More than 200 thousand people benefited from the initiative in 2023, including students, educators, and intersectoral teams^{15,18}

Industries can partner with schools and universities to develop technical training programs, improving the qualification of the local workforce. With the need for specialized training, the population can be encouraged to seek more education, which can reflect positively on the HDI.

- Health and Quality of Life

The installation of a factory can also bring challenges related to the health and quality of life of the population. Exposure to pollutants, as pulp production can generate air and water pollution, which can impact the health of the population and, consequently, life expectancy, one of the components of the HDI.

On the other hand, the improvement in the economy can lead to investments in healthcare infrastructure, increasing access to medical services, and improving quality of life. The World Health Organization¹⁹ defines the social determinants of health as: "the conditions in which people are born, grow, work, live and age, and the broader set of forces

and systems that shape the conditions of daily life. These forces and systems include economic policies and systems, development agendas, social norms, social policies, and political systems.

Indirectly, the implementation of a pulp industry can also generate social and environmental impacts, from social conflicts reflected in inequality, as economic growth may not be equally distributed, leading to social tensions and increased inequality, which can harm human development in general. And also in the displacement of communities, considering that the expansion of industry can result in the displacement of communities, which can negatively affect social cohesion and quality of life^{8,9}.

The HDI is measured based on three pillars: health, education, and income⁵. With the implementation of the factory, the average income of the local population tends to increase due to the direct and indirect jobs generated, in addition to greater tax collection for the municipality and the state. Investments in infrastructure and public health also improve quality of life indicators²¹. Therefore, the presence of pulp mills in the interior of the state has the potential to raise the HDI of the municipalities, promoting economic and social development in an integrated and sustainable manner, in a similar way to the extreme south of Bahia²⁰. These effects should be monitored in the coming years to assess the real impact of the mill on the HDI of Mato Grosso do Sul and to identify areas for improvement and continuity in supporting regional development^{1,13, 15}.

In the environmental aspect, the Ribas do Rio Pardo unit adopted sustainable practices, such as the use of biomass for energy generation and self-sufficiency in the production of inputs such as sulfuric acid and hydrogen peroxide. The factory also has a forest base with an average radius of only 65 km, which reduces environmental impact and logistics costs. This commitment to sustainability aligns companies with environmental, social, and governance practices³.

- Environmental Sustainability

The need for sustainable practices is crucial. If the industry compromises natural resources, it can have long-term impacts on health and the local economy, negatively affecting the HDI. There is no doubt that the implementation of pulp and paper mills contributed to the significant increase in the volume of income generated in the municipality. However, it is necessary to understand this finding within its limits and not to use it as an attempt to annul the analyses referring to the exploitative (capitalist) system, since we are

referring to a system that has in its essence the unlimited exploitation of resources and wealth, at the expense of reaching a higher stage of development⁸⁻¹⁰.

It should be noted that the impacts of monoculture eucalyptus plantations are sufficient to question laws that promote environmental flexibility for eucalyptus plantations due to commercial liberalism, this monoculture activity that has the purpose of trade, whose conventional management is based on pesticides and chemical fertilizers, with intensive use of water in the planting and production of cellulose pulp, and because it is a monoculture, it simplifies nature, destroying socio-biodiversity, unbalancing flora and fauna^{16,21}.

The state of Mato Grosso do Sul has as an important biome, the Cerrado, which throughout its history of occupation, has suffered many impacts, which has contributed to the alteration and, in large areas, the elimination of native vegetation covers, with the consequent impacts on all other forms of life and the general functioning of the related systems, which is why the inspection process is necessary to monitor the processes arising from this industrialization^{22,23}.

However, in addition to job creation, there was investment in improvements in urban and social infrastructure, including the expansion of the municipal hospital, the construction of schools and police stations, and the development of professional training programs, in partnership with the National Service for Industrial Learning (Senai) and the National Service for Commercial Learning (Senac). These actions have a direct impact on health and education indicators, which are fundamental components for raising the local HDI^{3,13,24}.

Another important investment for the state that will soon be reflected in the HDI indicators, mainly considering the influence of the pulp sector, is the construction of the Bioceanic corridor, designed to connect the Pacific and Atlantic oceans through a road route aimed at the integration of the South American continent, with the objective of transporting agribusiness production from the state of Mato Grosso do Sul, which has markets as its main destination such as China and Mercosur countries, which transforms the state into a major logistics hub, becoming a major center for imports and exports. This corridor aims to shorten the travel time of exports of agricultural products from the Midwest to the Asian market by approximately 17 days and reduce the cost of transportation by 23%, which is the main consumer of production²⁶.

4 FINAL CONSIDERATIONS

The implementation of a pulp industry has the potential to significantly impact the Human Development Index of a region, with positive and negative effects. Increasing income and education can raise the HDI, but environmental and social challenges must be managed effectively to ensure that development is sustainable and inclusive, since the simple increase *in per capita* income, associated with possible economic growth, is not enough to understand the complex structural changes that are characterized by the process of economic development. To maximize the benefits and mitigate the risks, it is essential that there is integrated planning, with the active participation of the community and local authorities, promoting development that respects both human beings and the environment. Since the increase in eucalyptus monoculture areas in the Cerrado highlights questions that deserve to be discussed because the potential risks of alterations and losses to natural systems are considered, which can directly impact the quality of health and HDI of the population.

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