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The importance of geography for distribution logistics in Brazil

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SUMMARY

Geography is crucial to distribution logistics in Brazil due to its territorial, climatic, and economic characteristics. Brazil has the 5th largest territory in the world and one of the largest road networks in the world, posing a major logistical challenge from north to south and east to west, transporting all types of goods. With such a vast and diverse territory, our country faces significant challenges, involving logistical actions and planning to transport various items across its more than 8 million square kilometers. It's important to understand that Brazil has several biomes, which influence routes and, consequently, logistical costs. In the state of Amazonas, for example, river transportation may be difficult, while in the Cerrado, agricultural transportation and commodity logistics are easier. Another important factor is that distribution is directly influenced by the concentration of industrial and urban centers, such as the states of São Paulo, Rio de Janeiro, and Minas Gerais. Regions like the North face greater challenges in receiving products due to their geographic location, increasing transportation costs and time. Understanding geography is essential to optimize logistics routes, reduce costs, and improve distribution efficiency. Investment is needed, particularly in railways connecting the country's most remote regions, such as the North and Northeast, to increase their commercial and industrial competitiveness. The Federal Government has invested modestly in rail transport; a recent example is the North-South railway, completed and in operation since 2018.

Keywords: Geography; Logistics; Brazil; Distribution.

ABSTRACT

Geography is essential for distribution logistics in Brazil due to its territorial, climatic and economic characteristics. Brazil has the 5th largest territory in the world, with one of the largest road networks in the world, posing a major logistical challenge from north to south and east to west, transporting all types of goods. With a vast and diverse territory, our country has a major problem to consider, which involves logistical actions and planning to transport various items across its more than 8 million square kilometers. It is important to understand that there are several types of biomes in Brazil, which influence the routes and, consequently, their logistics
costs. In the state of Amazonas, for example, there may be difficulties in river transport, while in the cerrado there is ease in agricultural transport and commodity logistics. Another important factor is that distribution is directly influenced by the concentration of industrial and urban centers, such as the states of São Paulo, Rio de Janeiro and Minas Gerais. Regions such as the North face greater challenges in receiving products due to their geographic location, increasing transportation costs and time. It is necessary to understand geography to optimize logistics routes, reduce costs and improve logistics distribution efficiency. Investments are needed, especially in railways that connect the most extreme regions of the country, such as the North

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and Northeast, making them more commercially and industrially competitive. The Federal Government has timidly invested in the railway model; a recent example is the North-South railway, which was completed and has been in operation since 2018.
Keywords: Geography; Logistics; Brazil; Distribution.

1 INTRODUCTION

This work analyzes the connection between the geography of Brazil and the logistics of distribution, highlighting the direct influence of geography on the planning and execution of logistics operations. It is crucial to understand the country's geographic dynamics and their relationship with distribution logistics to ensure efficiency and timeliness in the delivery of products to consumers. [1]

Logistics is defined as a process of planning, implementation and control the efficient flow of goods, services and information from origin to consumption, aiming to meet customer demands (Ballou, 2006). Christopher (2008) complements this definition by describing logistics as a strategic process that involves the purchase, transportation and storage of inputs and products, in addition to the flow of information between the organization and marketing channels. For him, logistics is crucial to create a cohesive plan for the flow of products and information, adding value with reduced costs.

Bowersox (2010) considers logistics as a continuous and complex phenomenon that occurs on a global scale, with the aim of making products and services available where and when they are needed. He notes that the growing consumer demand for high quality products requires that all production and marketing activities integrate the logistic function.

Geography is a fundamental pillar for distribution logistics in Brazil, our country has continental dimensions, our geography is diverse and complex, containing different biomes and climates. In this context, its role is of utmost importance relevance for the planning and execution of logistics operations, since factors such as climate, biome and location, has a direct impact on logistics operations, directly contributing to increased logistics costs and delivery times. In our country the main mode of transport is road, with 1,720,909 kilometers being the fourth largest in the world, through which 65% of all cargo moved in the territory passes Brazilian.

Geographical elements such as relief, climate and their natural characteristics have a direct influence on logistics, for example: Areas with mountainous relief or with large afforestation may require different types of transport, such as rail, river or air. Technological advancement and the purpose of optimizing distribution logistics, is possible to use digital maps of rural areas, cities, highways and streets, with a lot of accuracy, this information contributes to an assessment to outline the best delivery routes. In an increasingly demanding and expansive market, it becomes It is mandatory to offer quality distribution, and above all, that it is punctual.
In this same perspective, Fisher (1997) points out the increase in the individualization of demand of customers, which increasingly demands more frequent deliveries. McCann (1998) highlights the influence of the company's location on results and frequency of deliveries.

In Geography, according to Santos (1978), the space that matters is the human or social space. this, therefore, being the object of Geographical science. Thus, in the search for the definition of object of Geography, Santos, recognizes that reaching this objective presents a task arduous and with a certain number of risks. Therefore, a valid debate arises at this time, asked by Santos (1978, p.120),

The location of distribution centers is also important for logistics. When they are located in strategic points, companies can reduce their costs transportation, maintenance, storage and inventory management. In this context, understanding Brazil's geographical particularities is essential to overcoming challenges and explore business opportunities, thus ensuring more integrative logistics and competitive.

The 1970s were characterized by large-scale investments, applied in extraction of natural resources and energy, transportation and infrastructure communication. For Piquet (1998), Brazil stood out as one of the Third World countries World that individually applied the most in this type of enterprise, through which an authentic mutation of the Brazilian economy was promoted.

This article seeks to discuss the importance of geography for logistics distribution in Brazil, analyzing how territorial characteristics can impact the logistics operations and at the same time, highlighting strategies to optimize flows of transportation and supplies in the country.

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2 PHYSICAL GEOGRAPHY AND ENVIRONMENTAL CHARACTERISTICS OF BRAZIL

Brazil's physical geography and environmental characteristics have a direct influence on distribution logistics, due to several factors such as: Territorial extension, diversity of relief, climates, biomes and inequality in infrastructure and transportation in each region of the country. These factors shape routes, their costs, and the efficiency of their operations. logistics, which directly impacts, for example, the flow of agricultural production to supplying consumer markets. The challenges are great, a country transcontinental with various types of biomes and climates, with its reliefs and plains largely rugged, hindering connectivity between regions. This makes the cost and delivery times are extended to longer periods, especially in areas with poor infrastructure.

> The Brazilian territory has a wide territorial extension, with a area exceeding 8.5 million km², which indicates the wide variety of physiographic aspects that make up Brazilian landscapes. Therefore, to better understand the territorial dynamics of Brazil, it is necessary study and analyze the natural phenomena of the Brazilian space, both in their characteristics and in their interdependent relationships. Therefore, the Physical Geography of Brazil aims to study and enumerate the descriptive and analytical understandings of the natural elements of the territory Brazilian, operating from four distinct fields of study, the namely: the lithosphere, the atmosphere, the hydrosphere and the biosphere. (PENA, p.45, 2021).

Road transport, which is predominant in the country, has been facing major challenges in mountainous regions, such as Serra do Mar and Serra da Mantiqueira, which requires a lot of investment from governments or concessionaires in signage and asphalt infrastructure, to guarantee user safety.

Figure 1: Serra do Mar – São Paulo

Source: Daniele Bragança – 2020

Figure 2: Mantiqueira Mountains – São Paulo

Source: Roberta Martins – 2023

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3 TRANSPORTATION INFRASTRUCTURE IN BRAZIL

Transport infrastructure in Brazil is of paramount importance for success logistics and its distribution, promotes the economy and regional development, which makes the connection between production centers and consumer markets and export areas. In However, the country faces major challenges related to quality and multimodal integration, Another point that draws attention is the regional inequality of its transport network. To increase their logistical efficiency, retail, grain and other goods companies consumption, has invested heavily in distribution centers, reducing the cost and time of delivery of these materials and becoming more competitive in an increasingly demanding.

The distribution center was initially defined as:

> a physical installation within a distribution structure dedicated to rapid movement of goods, carrying out (1) receiving and shipping of goods (2) storage and/or transfer and/or cross-docking and (3) (optional) performing value-added logistics (VAN HOEK, 1996, p. 54).

Lambert et al (1998) discuss the reasons for the existence of centers of distribution, such as: greater bargaining power with suppliers, i.e. discounts in bulk purchasing; quick response to customer needs; support to just-in-time programs for suppliers and customers; consolidation of a product mix be delivered to the customer, rather than a single product at a time and; temporary storage of materials to be discarded or recycled. For Lacerda (2000), the choice of positioning and function of storage facilities is a strategic definition, since they are responsible for receiving consolidated loads from various suppliers, these loads are split in order to group the products in quantity and correct assortment and are then forwarded to the nearest points of sale.

For Alves (2000, p. 139), the functions of distribution centers go beyond traditional functions of warehouses, sheds or storerooms. For the author, the warehouses are “facilities whose main purpose is to store products to offer to customers”;

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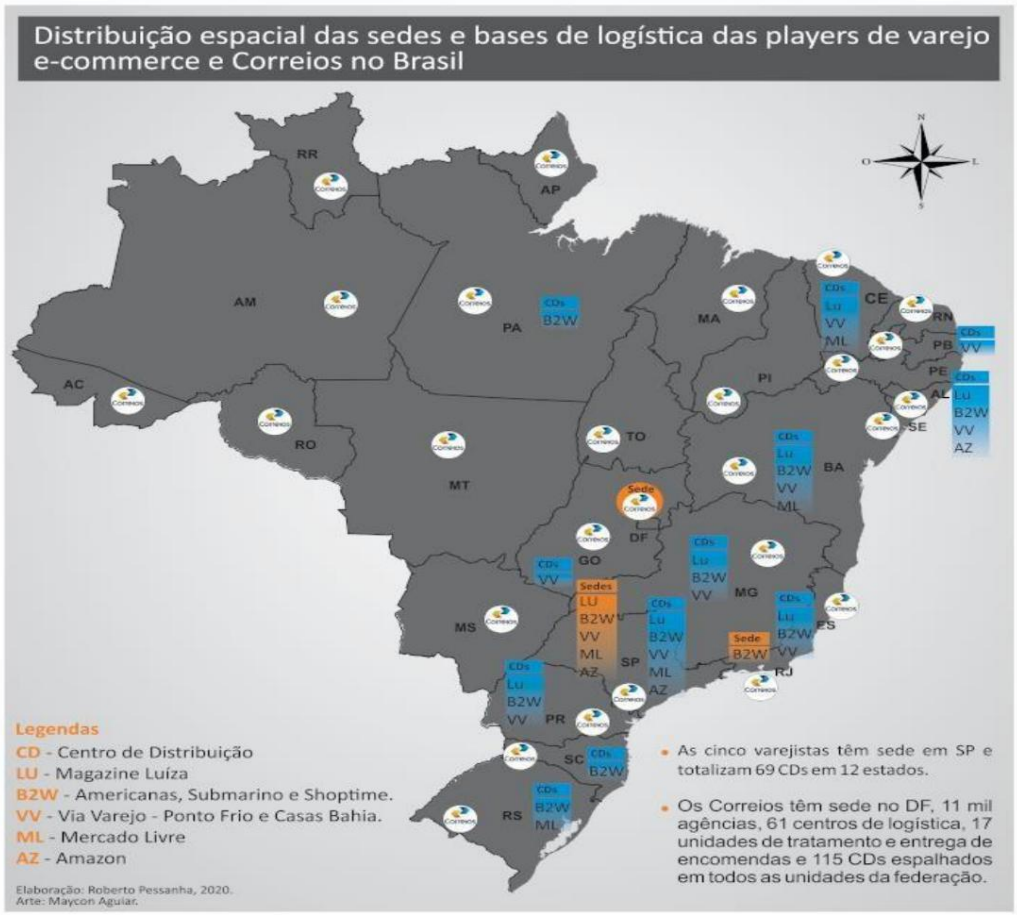
Distribution centers are “facilities whose purpose is to receive products just-in-time, from in order to meet customer needs.”

In Brazil we have dozens of distribution centers, this logistics infrastructure brings countless benefits to those who sell, transport and buy products. The main benefits of CD are: Logistics efficiency, reduction of operational costs, advantage competitive in relation to its competitor, Reduction of the delivery time of a product, reduction of road transport and greater profitability.

Regions are subject to discursive struggles over mapping and naming (Jenson, 1995; Paasi, 2004; Sidaway, 2002) that are analogous to earlier struggles over formation of imagined national communities (Anderson 2008); and for more substantive information about its social and material development and institutionalization space-time.

Some retail distribution centers in Brazil such as: Magazine Luiza, Amazon, Mercado Livre, Americanas, etc.

Figure 3: Spatial distribution and retail logistics bases



Source: Comciência – 2020

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4 MODES OF TRANSPORT IN BRAZIL

The predominant mode of transport in Brazil is road transport, which is responsible for about 65% of cargo and 95% of passengers, mainly on lines municipal and interstate buses. This type of transport has the advantage of being flexibility and capillarity, reaching remote routes and regions. The mode Rail represents around 20% of the transport matrix in Brazil, with more used for commodities, such as grains and minerals, the government and the private sector, has made some agreements to expand this mode, which will be very beneficial for our economy. On the other hand, we have the use of waterways, where their use is minimal. Although Brazil has the largest hydrographic network in the world, the use of public transport waterways are used timidly in the country and do not cause major environmental impacts, has low operating costs and its usage demand consists mainly of the region Northern Brazil, especially in the Amazon.

Air transport is mainly used for transporting passengers and cargo. of great urgency, it is worth remembering that this type of logistics is very expensive, and in most cases is sometimes unfeasible for commercial purposes. Despite being very fast, it has a high price. And finally, the maritime or port mode, which are responsible for 95% of the flow of foreign trade, transporting large volumes of cargo, such as commodities, grains, minerals, iron, and oil. Brazil has one of the best port infrastructures in the world. world, playing a fundamental role in the global food supply, in countries such as China, the USA and Europe.

One of the factors of economic growth of a nation is directly related to the ease of mobility and accessibility of its population in terms of urban displacement, between regions and countries, as well as the flow of their production goods so that they reach the points of consumption, whether in the national context or international. In this sense, operating costs can be decisive in competitiveness of these products. According to PNLT (2006), it is estimated that avoidable logistics costs, if Brazil's transport matrix were more balanced, they would be around US$2.5 billion per year, considering the reduction in transportation costs for certain loads, freight rates could be reduced by 62% for waterways and 37% for rail compared to road transport.

According to data from CNT (2013), road transport has its largest share, as shown in figure 1 with 61.1% of the loads, followed by rail with 20.7% and waterways with 13.6%, representing 95.4% of all cargo transported in the Brazilian context. Thus, it can be seen that better dimensioning with the use of modes with lower costs, may generate better competitiveness for Brazilian products.

Figure: 4 – Transport modes in Brazil

Source: Metaro – 2024

5 INTEGRATION BETWEEN GEOGRAPHY AND LOGISTICS

The integration between geography and logistics takes place in a practical way in Brazil, considering the country's geographical diversities, providing crucial information for the distribution logistics, such as the location of production centers, characteristics environmental factors for choosing transport routes and the influence of climate on modes logistical. Furthermore, geographic analysis helps identify potential bottlenecks logistics, enabling route optimization and strategic distribution planning.
In this way, it is possible to see how geography plays a fundamental role in support for distribution logistics in Brazil. (CABRAL et al. 2023)

In practice, geography is fundamental for distribution logistics in Brazil, as climate variations and different biomes directly impact the choice of most suitable modes of transport for each region, influencing costs and delivery times

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delivery. In addition, transportation infrastructure, such as highways and railways, is heavily influenced by the country's physical geography, a crucial factor in distribution efficiency. geospatial analysis also allows you to identify the best locations for installing distribution centers and warehouses, considering proximity to suppliers and customers, minimizing logistics costs. Therefore, the integration between geography and logistics in practice contributes significantly to the optimization of processes distribution in Brazil. (IBGE, 2014)

6. CASE STUDIES

An example of a company that highlights the importance of geography for logistics distribution in Brazil is Ambev, one of the largest breweries in the country, according to the brand. Headquartered in São Paulo-MG, created in Brazil, today it serves a total of 16 countries. Americas. In Brazil, according to data provided by the company, Ambev has 32 breweries, 2 maltings, 35 thousand "collaborators", 100 centers of distribution direct.

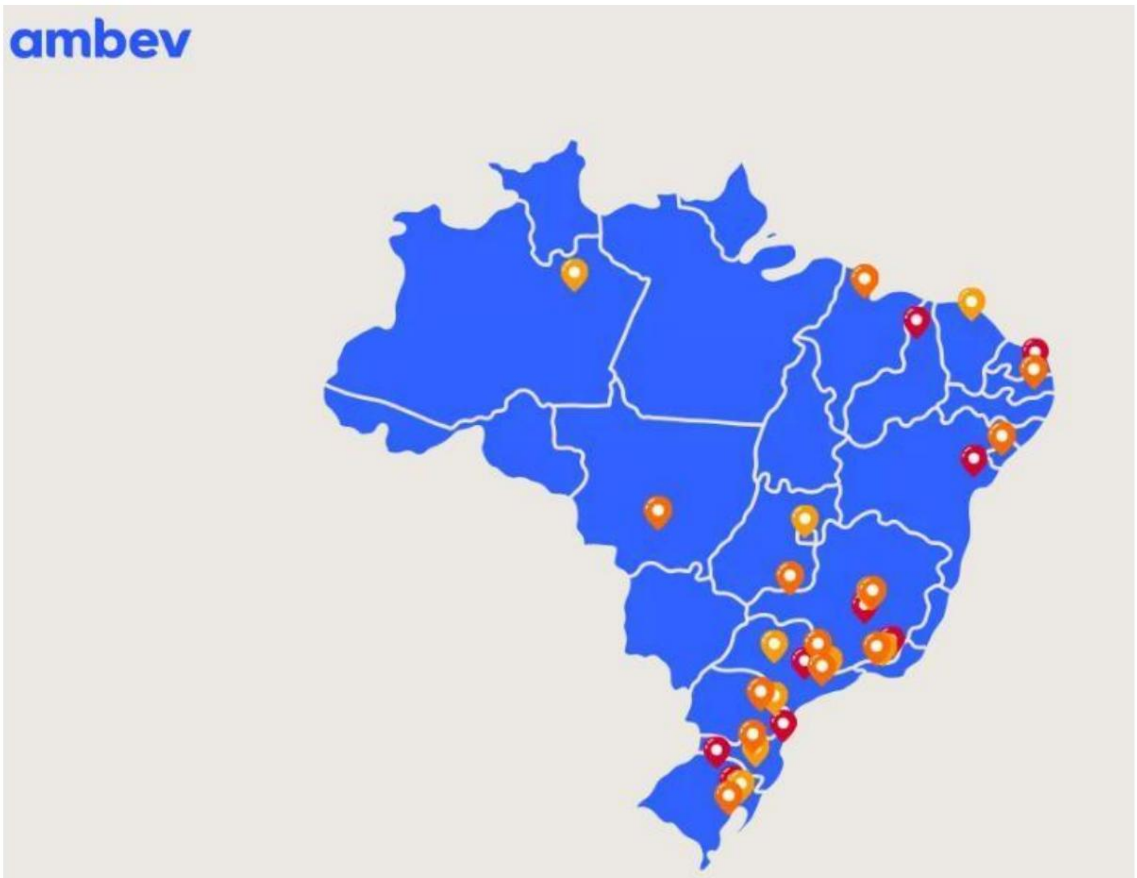

Image from the website: https://www.ambev.com.br/sobre-ambev

AmBev was formed in 1999 by the merger of Companhia Antarctica Paulista and Companhia Cervejaria Brahma, two of the largest Brazilian beverage companies, which grew from family roots (SILVA, 2006). In 2013, the company's net revenue AmBev surpassed Brazil's GDP by 23.9% and the country's beer production by 30%, demonstrating the success of its strategy (AMBEV, 2014).

Initially, Brahma and Antarctica outsourced the distribution of their products to strengthen its brands regionally, adopting a “spraying of the service” with the aim of having at least one dealership in each municipality (SILVA, 2006). This practice increased the number of distributors, but also restricted their areas of activity and reduced their profit margins, generating dependence on brands.

With distribution costs representing more than 20% of sales and reaching up to 30% of the final price, the situation became unsustainable for manufacturers (DANTAS, 2000). In response, in the early 1990s, Brahma began investing in Direct Distribution (CDD), with the first opened in 1996, operating as an extension from factory stocks (SILVA, 2006).

After the merger, AmBev restructured its distribution system to include a combination of Direct Distribution Centers and resellers, aiming to reduce costs and serve large customers directly. This new approach has enabled greater efficiency in deliveries, with better vehicle occupancy, increased volume per point of sale and route optimization, resulting in significant savings in logistics costs (VASCONCELOS, 2004; SILVA, 2006). The company uses geographic analysis detailed to identify the best locations for installing distribution centers, considering aspects such as proximity to production centers, access to the main highways and consumer demand in different regions.

The location of facilities is a fundamental strategic decision in the management of operations and the supply chain, directly impacting efficiency, costs logistics and the competitiveness of organizations (Slack, 2019). Slack et al. (2021) define this process as choosing the ideal location for factories, distribution centers or points sales, aiming to optimize results. (ALMEIDA, 2024)

Technological developments, such as artificial intelligence, machine learning and analytics

geospatial through Geographic Information Systems (GIS), transformed the traditional localization approaches, allowing greater adaptation to changes in the business environment (Rabbani et al., 2022; Murray; Grubesic, 2007).

7. TECHNOLOGIES AND INNOVATIONS

One of the most relevant technological advances for distribution logistics in Brazil is implementing geographic information systems (GIS). These tools allow the analysis and visualization of geospatial data, which are essential for the planning and optimization of routes, location of distribution centers and real-time fleet monitoring. Furthermore, GIS contributes to the identification of risk areas, enabling the adoption of preventive measures. With the integration of geographic data and logistical information, companies can make more informed decisions efficient, reduce operating costs and improve the quality of services provided to customers.

7.1. GEOGRAPHIC INFORMATION SYSTEMS

In the 20th century, cartography underwent a significant revolution thanks to the use of aerial photogrammetry and electronics in surveys. In order to meet the needs various human activities, contemporary cartography seeks to mass-produce maps accurately and quickly, using technologies such as remote sensing, GNSS and GIS. These technological advances, along with the popularization of the World Wide Web, facilitated the distribution of geospatial information and enabled the storage and the combination of data on territories.

Taylor (1991) proposed a new vision of cartography, considering it a tool for organizing, presenting and using geoinformation in different formats. Field and Cartwright (2013) highlight that GIS have expanded opportunities for cartographers, promoting a “new peak of cartography” through mapping democratized and cloud computing.

Geovisualization, as mentioned by Hamburg (2013), involves the virtual exploration of 2D and 3D spatial data. However, Field and Cartwright warn that, despite the increase in the number of maps available, this does not guarantee that all

are of quality, with risks of inaccuracies in non-professional maps that can affect decision-making.

A Geographic Information System (GIS) (GIS), is a set of computational tools that allows geoprocessing, integrating data from different sources to create databases with information georeferenced. According to Fitz (2008), GIS are designed to collect, store, process and analyze this data, generating spatial information. Bossler (2016) adds that they operate mathematically with geographic and alphanumeric data, using predefined algorithms. GIS offers advantages such as speed in data processing and the possibility of complex analyses that assist in decision making decision-making (HAMADA and GONÇALVES, 2007). They are applied in several areas of knowledge, including social, human, exact and biological sciences, adapting to specific concepts of each discipline (CÂMARA and MONTEIRO, 2001).

Geographic information systems (GIS) play a crucial role in distribution logistics in Brazil, as they allow data analysis and visualization geospatial tools to make strategic decisions. Through mapping and integrating different layers of information, companies can identify the best routes of transportation, storage and distribution areas, as well as forecasting demands and optimizing logistics. Furthermore, GIS enables real-time monitoring of operations, providing accurate information to ensure the efficiency of the logistics process in a country of continental dimensions like Brazil.

According to Francisco (2014) the functions of a GIS allow you to calculate the distance between objects in space, the length of rivers and highways, as well as municipalities and states.

The use of Geographic Information Systems (GIS) in logistics offers several advantages that can optimize operations and improve decision-making. The use of GIS allows for more efficient route planning, reducing time and cost. transportation. It helps identify the best route, considering factors such as traffic, distances and road conditions, enables the analysis of the location of warehouses, deposits, optimizing for the construction of strategic points, improving the flow of products.

An important analysis would be the market/customer comparison, since it can be customize regional needs with the purchasing pattern, better understanding the

market and thus invest in a specific growing area.

The advantages mentioned make GIS a powerful tool for optimizing logistical processes, contributing to efficiency and cost reduction.

8. CONCLUSION

In Brazil, the main geographical challenges for distribution logistics include the extent of the territory, the diversity of biomes and the varied climatic conditions. This has a direct impact on transport infrastructure, with difficulties in accessing certain regions and the need to adapt transport modes. On the other hand, hand, opportunities are related to the wealth of natural resources and the extent of sea coast, providing alternatives such as water transport, as well as possibility of developing strategic routes. Thus, Brazilian geography presents both challenges and opportunities that directly influence the logistics of distribution.

In the context of distribution logistics in Brazil, geographic factors play a crucial role in operational efficiency and strategy. The extension territorial of the country, together with the diversity of biomes and climatic conditions, directly influences the planning and execution of transportation and distribution goods. In addition, the presence of mountain ranges, rivers, and difficult-to-access areas also impacts the definition of routes, the choice of transport modes and the management of inventories. Therefore, it is essential to consider these geographic factors when developing efficient and economical logistics strategies in Brazil.

This study clearly demonstrates the importance of geography for logistics distribution in Brazil. Understanding the environmental characteristics, infrastructure of transportation and its integration with logistics are crucial aspects for planning and effectiveness of operations. In addition, case studies and identification of challenges geographical and opportunities offered by the country highlight the relevance of the topic for companies. The application of technologies and innovations, such as information systems geographically, can contribute significantly to the optimization of logistics processes. Thus, geography proves to be an essential element for the success of distribution. goods in Brazilian territory.

The integration of geography with distribution logistics proves essential for the efficient operation of companies in Brazil, given the geographical diversity and complexity of the country. Geography provides fundamental data that directly influence the choice of transportation routes, the location of distribution centers and decisions about modes most suitable, taking into account climate variations and infrastructure available.

Practical examples, such as the AmBev case, illustrate how a geographic analysis detailed can optimize logistics processes, improving distribution efficiency and reducing operating costs. The company uses tools such as Management Systems Geographic Information Systems (GIS) to collect, process and analyze geospatial data, enabling informed decisions about warehouse locations and delivery routes.

Furthermore, the adoption of innovative technologies such as artificial intelligence and predictive analysis, transforms the traditional approach to logistics, allowing companies adapt quickly to market changes and customer needs consumers. Geospatial analysis helps identify logistical bottlenecks and plan distribution strategies effectively.

In short, the intersection between geography and logistics is vital to optimizing this process in Brazil. This combination not only improves operational efficiency, but also promotes a better customer experience, allowing companies to meet market demands more effectively and remain competitive in a dynamic and challenging environment.

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