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Proposal for water transport in the capital of Amazonas, using a GIS tool

LEONARDO FERNANDES AUZIER
Federal Institute of Education, Science and Technology of Amazonas (IFAM)
Infrastructure Department (DAINFRA)
Coordination of the Civil Engineering Course
Manaus – AM
IRAÚNA MAICONÃ RODRIGUES DE CARVALHO
Federal Institute of Education, Science and Technology of Amazonas (IFAM)
Infrastructure Department (DAINFRA)
Coordination of the Civil Engineering Course
Manaus – AM

Abstract

The capital of Amazonas has a peculiarity from other cities in Brazil due to a vast extension of water flow from the Rio Negro around the urban area. Around the city there is a large community of riverside dwellers who live in river houses and their only alternative to get around the urban center is water transport. In view of this, through the use of a GIS tool, the objective of this article is to verify the potential of the water resource around the city of Manaus for the implementation of an urban waterway transport, thus, a new suggestion of public transport to the society that lives in the urban area and in the perimeter of the municipality.

Keywords: water Transport, Manaus City, Brazil.

1. INTRODUCTION

The situation of the transport infrastructure, in a way, not only affects the smooth running of the economy and competitiveness of countries, but also the quality of life of its population. This has only increased over time the concern for investments in infrastructure, both in the academic area and in institutions responsible for the evaluation and formulation of public policies in the context of transport infrastructure (RIBEIRO, 2010).

Brazil is privileged for having almost eight thousand kilometers of coastline, which gives it enormous capacity for the use of cabotage waterway transport, which directly contrasts with the little use of this modal. The

country transports most of its cargo (58%) through highways, which represents an imbalance in its transport matrix (REIS, 2013). Although the city of Manaus does not have a coastal coast, its geographical position bathed by the Rio Negro is similar to that of cities bathed by oceanic waters, although the draft and flow are not the same, the movement of large vessels is almost similar, a since large inputs that are imported from other countries and states come from waterway transport.

The geographic landscape of the Amazon is gigantic, endowed with the largest equatorial forest on the planet, with large and extensive water courses that run over great distances. It is in this immense territorial context that the logistics scenario of cargo and passenger transport in the State of Amazonas is inserted, equipped with small vessels called Regional, Recreation or Motor Boats. Managed with informal administrative practices, with no records of the costs incurred for the formation of prices. This lack of knowledge, together with the lack of standardization of waterway passenger transport rates, means that users do not have a pre-defined fair value for their transfers and, also, the operator itself is unable to determine whether it incurs profit or loss. (MOURA, 2017)

Urban waterway transport emphasizes aspects related to public transport in terms of rationalizing fuel consumption, reducing travel times, improving the quality of the service offered and increasing safety (BNDES, 1999).

Navigation allows and enables the expansion of economic activities and agricultural frontiers. According to Lacerda apud Souza et al (2005), waterway transport handled around 23.6 million tons in 2001, growing at rates higher than the growth of national GDP, with an increase of 21% between 1998 and 2001.

About 700 companies and 5,000 vessels operate commercially in the Amazon region, generating 40,000 direct jobs (waterways) and 30,000 indirectly (in terminals and shipyards). However, it is worth mentioning that the current waterway transport system in this region still does not adequately serve the displacement of passengers as well as cargo in general.

The waterway modal uses the greatest natural resource available on the planet as the means of locomotion, water. This modal includes waterway transport (river and lake), called inland waterway and maritime transport, which is divided into long-distance maritime transport, characterized as international navigation taking place between ports of different countries, and in cabotage navigation, which is national navigation carried out between sea ports or located on rivers in the same country. In turn, cabotage navigation can be divided into small and large cabotage, according to its scope (ANDRADE, 2007; NOVAES, 2007).

According to Souza (2009), the transport sector has received pressure from related changes in the economy, with the need to make adjustments in accessibility levels and the supply of road infrastructure, including terminals, fleets, urban contours, etc. , including new services, as well as improvements in the conditions of integration between them.

The objective of the research is to present new solutions for urban transport in the city of Manaus with an emphasis on water transport, using the ArcGis tool to expose the large water extension of the Rio Negro to the surroundings of the urban city and selecting strategic points for the embarkation and disembarkation area of passengers.

The neighborhoods analyzed will be the neighborhoods that are bathed by the waters of the Rio Negro and Rio Solimões.

2. METHODOLOGY

First, a bibliographic research was carried out on the theme "Water potential for waterway transport", seeking information to improve the transit of Manaus, with an emphasis on the waterway modal as a new transport alternative in the capital of Amazonas.

Some similar situations were analyzed in other cities that used the waterway modal for urban purposes, such as New York, Malaysia and Venice.

Then, information was sought from the neighborhoods that are located in the vicinity of the city of Manaus and access to information from riverside residents who live near the urban area of Manaus and use the only means of transport (waterway) to access the urban area.

Finally, through the Arcgis tool, the technical maps were made to access the exposure of data on the possibility of water reuse for the use of waterway transport.

2.1 Water transportation

According to the urban mobility plan for the city of Manaus, developed by the company oficine Consultores, there is a guideline among their suggestions for the use of the edge, according to table 01.

Diretriz 7	**Tratamento e ampliação do transporte hidroviário**
Diretriz 7.1	**Requalificação e reurbanização do Igarapé Mindu**
Ação 7.1.1	Desenvolver estudo específico do potencial de transporte de passageiros e cargas no Igarapé Mindu
Ação 7.1.2	Implantar passeios e passarelas ao longo do sistema viário a ser construído ao longo do Igarapé Mindu
Ação 7.1.3	Implantar ciclovias ao longo do sistema viário a ser construído ao longo do Igarapé Mindu
Diretriz 7.2	**Ampliação do transporte hidroviário**
Ação 7.2.1	Desenvolver um estudo específico para o transporte ao longo da orla do Rio Negro
Ação 7.2.2	Desenvolver um estudo sobre o potencial de transporte dos grandes igarapés

Table 01 - Guideline 7 – Treatment and expansion of waterway transport.
Source - Plan.Mob

According to table 01, there is an incentive within the city's master plan to encourage the use of the water potential around the Amazonian capital, so it is a great challenge and an incentive to local regional research for improvements in public transport in Manaus.

2.2 Evaluation of the Road Transport Economy x Waterway Transport

Carvalho *et al* , in 2017, prepared a study regarding the proportion of cost of road and water transport, according to table 02.

Condição do Tempo	Transporte	Litros (Gasolina x Custo)	Velocidade (Km/h)	Distância percorrida (km) / Tempo (HORAS)
Predominantemente ensolarado.	Transporte aquático (Lancha do tipo "voadeira"	42 Litro x 161 R$	70 Km/h	115 km / 1,91 H
Predominantemente ensolarado.	Rodoviário (Ônibus)	56 Litros x 212, 50 R$	50 Km/h	65 Km / 4,25 H

Table 02 - Modal Costs
Source - XVI RDT 2017, Carvalho *et al*

The table exemplifies how economical the use of water transport can be, in relation to time and fuel consumption, so it is suggested as another factor that may be favorable regarding the application of its uses as an alternative in public transport in the capital.

2.3 Covered neighborhoods

According to IBGE (2010), the Municipality of Manaus recognizes 63 official neighborhoods, among the 63 neighborhoods, 17 are located near the banks of the Rio Negro, totaling approximately 30% of its total. According to table 03 are the neighborhoods close to the edge of Rio Negro.

Neighborhood	Region
buriti village	SOUTH ZONE
Tarumã-Açu	WEST ZONE
San Raimundo	WEST ZONE
Saint Anthony	WEST ZONE
Saint Augustine	WEST ZONE
Puraquequara	EAST ZONE
Black tip	WEST ZONE
Our Lady of Aparecida	SOUTH ZONE
badass	SOUTH ZONE
students	SOUTH ZONE
Industrial District I	EAST ZONE
compensation	WEST ZONE
Oliveira Machado Colony	EAST ZONE
Antônio Aleixo Colony	EAST ZONE
center	SOUTH ZONE
little waterfall	SOUTH ZONE

Table 03 - Neighborhoods of Manaus
Source - Google Academic

30% of the neighborhoods of Manaus contemplate the edge of the Rio Negro in its territorial extension, where there is at least one representative of each neighborhood in the divided regions of the Amazonian capital.

2.4 GIS Tool - Arcgis

The Geographic system Information System (GIS) was first implemented by the British geographer Roger Tomlinson in partnership with the companies IBM and Spartan Air Services, in 1963, with the purpose of creating a national inventory of natural resources. Information System (CGIS), the tool by which it is used for global geoprocessing works and used in this article.

According to google academic, ArcGIS is a family of client software, server software, and online geographic information system (GIS) services developed and maintained by Esri. ArcGIS was first released in 1999 and was originally released as ARC/INFO, a command-line based GIS system for manipulating data.

3. RESULTS

With the information from the data exposed in the methodology, the final product of the technical map of the neighborhoods close to the edge of the Rio Negro is concluded, since the use of water transport in that place is suggested.

In image 01 the whitish color is the representation of the urban area of the urban city of Manaus, each delimited area represents a neighborhood.

In image 02, the line with neon blue color represents the meeting point between the hydrographic axis of the Rio Negro and the perimeter of the urban area of the city of Manaus.

In image 03, we have in the delimited area of the neighborhoods, representing the urban area of the capital, in brown color tone, and in neon blue color is the representativeness of the hydrography path of the black river path in proximity to the capital's barros.

Image 01 – City Map
Source: Own.

Image 02 – Delimitation of the river close to the neighborhoods
Source: Own.

Image 03 – Neighborhoods close to the waterfront
Source: Own.

4. CONCLUSION

This study, in addition to providing a new alternative in public transport in Amazonas, it represents an innovation in the Brazilian urban transport modality, where the usual is the modality of land and rail modals.

The waterway transport modality is already quite usual for riverside people who live close to the urban region, so this becomes more suggestive to the public and another incentive for the government to evaluate the great water potential we have around the urban region of Manaus.

The Manaus urban mobility plan includes in its prepositions, guidelines to encourage more studies related to waterway transport. A dynamic study evaluation of cost x advantages between land and waterway modal would be for a suggestion of future study to evaluate the most effective performance for the population in relation to costs and travel time.

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