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POPULAR SCIENCE

The impact of climate change on Argentina's land transport infrastructure

El impacto del cambio climático en la infraestructura del transporte terrestre en Argentina

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Abstract

This article reflects on how climate impacts can affect transport infrastructure and thus compromise operational safety. It also details some of the mitigation measures proposed as an initiative of the National Action Plan for Transport and Climate Change (PANTyCC, Ministry of Transport, 2017), and lists the major impacts recorded and the most appropriate recommendations to meet the challenges of future scenarios.

Resumen

Este artículo reflexiona sobre cómo el impacto climático puede afectar la infraestructura del transporte y, por ende, comprometer la seguridad operacional. Además, detalla algunas de las medidas de mitigación propuestas como iniciativa del Plan de Acción Nacional de Transporte y Cambio Climático (PANTyCC, Ministerio de Transporte, 2017), y enumera los mayores impactos registrados y las recomendaciones más adecuadas para enfrentar los desafíos de los escenarios futuros.

According to 2017 data from the National Institute of Statistics and Censuses (INDEC), the transport sector fulfills essential functions for Argentina's development as it promotes the mobility of people and goods, contributing 4.4% of the total national gross value added of the economy. It also generates approximately half a million jobs according to the Observatory of Employment and Business Dynamics of the Ministry of Labor, Employment and Social Security (MTEySS) based on the Argentine Integrated Social Security System (SIPA).

Regarding the freight sector, the preponderance of the road mode (92.7%), followed by the rail (3.7%) and the river-maritime mode in ships and barges (3.6%) stands out; air cargo has a minimal share (data collected from the National Action Plan for Transport and Climate Change -PANTyCC-, Ministry of Transport in 2017).

The PANTyCC represents the set of initiatives that Argentina has planned to contribute to the reduction of greenhouse gas (GHG) emissions and adapt to the effects of climate change in the transport sector, in accordance with the commitments assumed before the United Nations Framework Convention on Climate Change (UNFCCC).

Focusing on road transport, it can be observed that climatic factors generate negative impacts on road infrastructure, mainly due to the deterioration of the asphalt layer, subsidence, pothole formation, waterlogging, among others. This has a direct impact on road safety. Within the Action Plan for the mode of land transport, it is evident that climatic factors have a negative impact on the structures of the road system and on the performance of the cargo rolling stock. The latter increases GHG emissions and slows down the achievement of the mitigation objectives assumed by Argentina by 2030. The set of mitigation measures considered will contribute to the reduction of 5.9 MtCO2eq in 2030 out of a total of 54.2 MtCO2eq of emissions in 2016, according to the 2016 national GHG inventory (INGEI). Hence, 95% of emissions correspond to the road sector, according to statistics from the National Department of Climate Change of the Secretariat of Climate Change and Sustainable Development of the Ministry of Environment and Sustainable Development.

> ***"Climatic factors generate negative impacts on the road infrastructure, mainly due to the deterioration of the asphalt layer, subsidence, potholes, flooding, among others."***

The PANTyCC is also complemented by adaptation measures to address the impacts of climate change through a series of interventions, mainly in transport infrastructure. The goal in Argentina for the year 2030 is to implement:

> "(...) Policies, measures and actions in the field of transport to provide better conditions for the mobility of people and goods, reduce times and prioritize safety, comfort and sustainability, in order to substantially reduce greenhouse gas emissions and promote climate change adaptation mechanisms that reduce the vulnerability of the sector to the impacts of this phenomenon".

As for the National Road Plan 2025, it consists of the development of road works and the use of specific asphalt that improve flow and physical conditions resulting in greater efficiency in mobility and lower

Climate Change Mitigation Actions

FREIGHT TRANSPORT	Railway hierarchy (loads)	Freight Railway Investment Plan (PIF) - Cargo derivation from truck to railway
	Improved efficiency in road freight transport	Intelligent Transport Program
		Driver training
		Fleet renewal with truck scrappage
		National Road Plan to 2025
		Limited maximum speed for truckst
	Urban freight transport circulation improvements	Paseo del Bajo

Source: extract from PANTyCC.

energy consumption. As an example of actions to be carried out: the construction of 2,800 km of new highways, 2,500 km of safe routes, 13,000 km of rehabilitated routes and 2,000 km of new pavements to optimize the operation of combustion engines; the construction of overpasses to improve circulation and reduce fuel consumption by avoiding interruptions in vehicular flows and congestion caused by low barriers and the emission of pollutants, particulate matter and GHGs by idling engines. In addition, the development of overpasses and viaducts improves transport safety in areas where rail and road modes cross.

According to the studies of the Third National Communication (TCN) on Climate Change (2015), during the period 1960-2010 an increase in the average temperature was observed in most of Argentina of around 0.5 °C, exceeding 1 °C in some areas of Patagonia, and there was an increase in the number of days with heat waves and a reduction in the number of days with frost. In terms of rainfall, the largest increases occurred in the east of the country, causing floods with a major socio-economic impact. In semi-arid areas, a decrease in rainfall was identified in the mountain range and a decrease in the flows of the rivers in Cuya. In relation to the potential impacts of climate change for the rest of the 21st century, another increase in average temperature of between 0.5 and 1°C is projected in most of the country, implying an acceleration of the warming observed over the last fifty years.

As for average rainfall, no major variations are expected in the coming decades. However, in the same vein, increases in the frequency of heavy rainfall events. Faced with these scenarios, in the countryside the waters run quickly in search of their natural channels, but sometimes, transport infrastructure works, railway and road lines interrupt the runoff of water in the water basins and increase flooding problems in urban and suburban areas. Although there are systems of gutters and sewers, these were dimensioned, designed and built without considering future projections linked to climate change, which makes them scarce or undersized. Among natural disasters, floods are the greatest threat to the country, in terms of economic damage and the amount of population affected (World Bank, 2016).

The main impacts by region are evidenced, according to the TCN, from the Ministry of Environment and Sustainable Development:

- water stress due to rising temperatures in the north and west of the country,
- potential water crisis in Cuyo,
- retreat of glaciers in the Patagonian mountain range,
- retreat of the average flows of the rivers of the La Plata Basin,
- sea level rise (affecting points of the maritime coastline and the coast of the Río de la Plata), and
- high frequency of extreme rainfall and flooding in northeastern Argentina (NEA) and western humid region.

> ***"In relation to the potential impacts of climate change for the rest of the 21st century, another increase in average temperature between 0.5 and 1 °C Is expected in almost the entire country, which would imply an acceleration of observed warming in the last fifty years."***

The Environmental Safety in Transport Area of the Transport Safety Board (JST) is working to monitor these occurrences as we consider that we are facing the potential risk of an increase in accidents, given the effects on the structure of the road system and freight transport that, therefore, has an impact on road and safety.

Today we can see, for example, forest fires, caused in part by heat waves, and droughts that affect transport and damage road structures, which in turn increase the risk of accidents due to lack of visibility, the movement of animals or soil erosion, among others. High temperatures and heat waves can damage both

asphalts, affecting its rigidity, as expansion, at bridge joints. In mountainous areas affected by torrential rains, the risk of accidents due to rockfalls increases. In addition, the lack of absorption of the asphalt system and the preparation of its structure for floods and frequent torrential rains can lead to deterioration of foundations and bridges. For all these reasons, we are obliged to think about strategies and policies to implement maintenance service levels of road structures appropriate to these new scenarios.

A risk-based approach is needed to identify appropriate mitigation and adaptation planning. The Permanent Observation Topics (TOP) will collaborate in the achievement of the objectives proposed in the PANTyCC to maintain safety at an acceptable level of risk. We believe that it is necessary to assess the effect of climate change on the national road network and to take corrective measures in terms of design, construction and maintenance of the road network. Along these lines, the PANTyCC proposes:

- The mapping of climate vulnerabilities and risks as a tool for diagnosing the situation and supporting the management of adaptation to climate change; Climate Change Risk Mapping System (SIMARCC), launched in October 2017.
- The economic quantification of the impacts of climate change and the implementation of adaptation measures.
- Capacity-building in human resources and improvement in inter-agency coordination for planning and management of climate change adaptation issues.
- The creation of multidisciplinary teams to support the various initiatives underway or planned. The development of structural and non-structural works to prevent floods, droughts and heat waves.

In summary, as the Second National Communication (SNA) on climate change describes:

> "The new infrastructure, both road and rail, must take into account the climate changes that have already been registered in recent decades and those that future scenarios project for the coming decades, both in its adaptation to the new water conditions in the design of bridges and other works and in its development as a network, because of the implications that these changes are having on the productive system" (Secretariat of Environment and Sustainable Development of the Nation).