

Roads to development



Roads to development

ImpactoCAF is an initiative created by the Department of Development Contributions and Impact Evaluation, under the Planning and Development Impact Division of CAF. The elaboration of this document was carried out by Lesbia Maris.

Lian Allub, Agustina Hatrick, Matías Italia, Mónica López, Daniel Ortega, Cecilia Paniagua and Héctor Varela provided valuable comments and suggestions to the document.

Additionally, this document benefited from the contributions of Matías Italia and Carlos Volcán.

Graphic design: Estudio Demaro / La Plata, Buenos Aires, Argentina

Editorial review: Rosario Inés De Rosa

© 2023 Corporación Andina de Fomento

The ideas and approaches contained in this edition are the sole responsibility of their authors and do not compromise the official position of CAF.



Roads to development

The road network facilitates both the transportation of people to labor markets and public services, and the trade of goods and services between different markets.

IN LATIN AMERICA, THE ROAD NETWORK:

- extends approximately **3.6 million kilometers**
- supports **almost half** of intra-regional trade
- facilitates **2%** of extra-regional trade¹

Although the region is one of the most urbanized in the world, around 100 million people live in rural areas and, for the most part, in conditions of moderate or extreme monetary poverty.² Of the total rural population, 40% live in remote areas without access to a land transportation network.³ They have limited access to health and education services as well as to technological innovations and markets that would allow them to improve the productivity of their economic activity (mostly subsistence agriculture).

The existing road infrastructure in Latin America and the Caribbean (LAC) faces significant quantity and quality deficits. The region has 188 km of roads per 1,000 km², 13% of the average road density in OECD countries. Only one-sixth are paved and permanently passable.⁴ Similarly, poor road quality impacts the region's accident rates: around 18 deaths per 100,000 inhabitants per year, slightly more than three times the average for OECD countries.⁵ Latin America's road network also has other deficiencies, such as abrupt decreases in service levels of main roads; poorly exploited or inefficient interconnections; complex geography and exposure to climate events; inadequate institutional and regulatory frameworks; and insufficient road maintenance activities.

The lack of roads or their poor quality negatively affects companies' performance and, as a result, economic activity. One in three companies in Latin America sees the region's transportation infrastructure as a barrier to productivity growth. Bringing populations closer together through more and better roads has enormous economic potential as it would open up more markets to businesses.⁶

CAF has made a strong commitment to road investment in LAC countries.

IN THE LAST FIVE YEARS ALONE, CAF HAS FINANCED:

58 credit operations

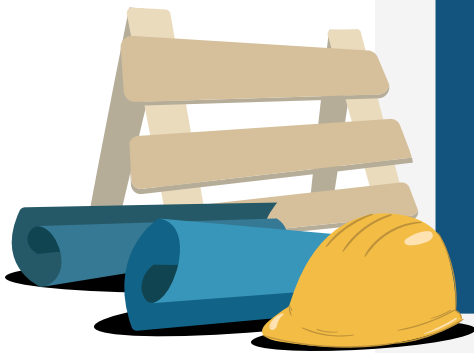
in the road sector

for **USD 4.8 billion**

to build, improve or rehabilitate at least

14,000 km

of roads in urban and rural areas^a



Financing projects for more and better roads

CAF finances projects for the construction of new roads and maintenance activities of existing roads.

Of the 58 credit operations approved by CAF in the last five years, 46 have included components for the construction and paving of new urban and rural roads in Argentina, Bolivia, Brazil, Ecuador, Panama, Paraguay, Trinidad and Tobago, and Uruguay. Some of these projects have included the construction of secondary and tertiary roads specifically aimed at improving connectivity in rural areas.

Twenty-seven operations included resources for improvement, maintenance, or rehabilitation activities on urban and rural roads in the same nine countries.

^a Calculation based on the number of kilometers projected at the beginning of the project in 30 credit operations.

Within CAF's initiative of integral interventions in cities, 22 of the approved operations have included urban interventions in Argentina, Brazil, and Ecuador. These projects included the construction, improvement, or expansion of streets or avenues and the construction of public transportation stations, bridges, and other road works to improve transportation safety and reliability.

The impact of CAF's road investment

The 40,000 km network of Inca roads, known as the "Tahuantinsuyo road network," was key to guaranteeing the survival of the largest empire ever seen in the Americas—and the largest in the world at that time— by facilitating the movement of people, goods, and armies. It also ensured the presence of its representatives throughout the territory.⁷ Today, roads continue to play an important role in linking people and businesses, thus expanding the possibilities for the exchange of goods and services.



Roads reduce travel time and cost and, depending on the type of road, can also increase the safety, quality, and reliability of travel. This is true for both rural and interurban roads, as well as for intra-urban roads.

For businesses, more convenient and less expensive transportation can expand the available markets, generating an increase in the production level of the most productive firms. In general, an increase in production implies a greater purchase of inputs, including labor, which, on the one hand, can increase employment and, on the other, the price of inputs, including wages. At the same time, greater access to markets can lead firms to concentrate more resources on activities in which they have comparative advantages, potentially causing a reallocation of resources in the economy from less productive sectors and/or firms to more productive sectors and/or firms.

Roads also benefit households, especially in remote areas. Not only can they travel to and from work faster for less money but they can also access new jobs with better salaries. Greater connectivity increases households' access to markets for basic goods and services such as health and education.

Lower commuting costs could also result in people and businesses moving to less populated locations, that are now better connected, as a result of the new infrastructure.

The benefits of reducing commuting costs are enhanced or attenuated by a combination of several factors.

The benefits of reducing commuting costs are enhanced or attenuated by a combination of several factors. They include the productive structure, ease of movement of goods and people, the characteristics of the different markets, consumer preferences, and the agglomeration/dispersion forces in the local economies.⁸

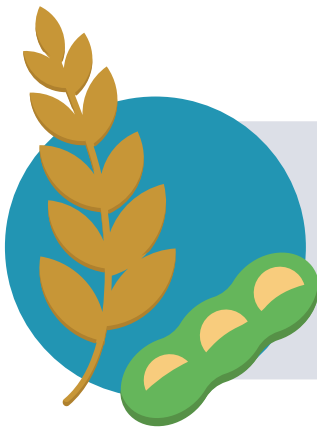
In addition, depending on the structure of the road network, connectivity improvements in some communities may actually be detrimental to others along the same network, whose supply (of labor, inputs, or goods and services) may face more competition from the communities directly benefited by the road improvements.

Indeed, although scientific evidence of the impact of road investment is generally very positive, it also provides a heterogeneous view of the benefits and their distribution within a territory.

The potential impact of CAF's road investment in different dimensions is presented below.

Transportation costs and market access

CAF's work has reduced transportation costs and travel times in the benefited areas. According to the evidence, greater ease of travel opens up new markets for firms. On the other hand, the investments increase households' access to labor markets and the availability of goods and services, perhaps at lower prices.⁹



In 2020, CAF approved USD 100 million to connect one of Paraguay's main agricultural production areas –Alto Paraná– with Puerto Indio via the Itaipú superhighway. The project seeks to improve the access of local producers to national and international markets.

Exports

Reduced travel costs and greater access to productive inputs increase competitiveness, which in turn can increase the level of exports from the benefiting regions.



Road investments in Peru, for example, enabled the completion of more than 5,000 kilometers of new roads between 2003 and 2010, and helped increase exports by 6.4%.¹⁰ In Africa, a one-day reduction in land transport increased exports by 7%.¹¹

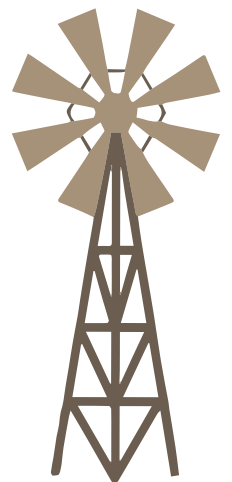
Employment, production, and wages

Improved access to markets made possible by CAF's road investment could help increase employment and production levels thanks to greater availability of inputs, logistics services, and new buyers.¹² The materialization of these benefits depends on the initial characteristics of the labor, goods, and services markets of the connected areas, as well as the availability of logistical services, land, and capital. Not every type of road improvement will generate all of the benefits described above, and likewise, not everyone in a locality will receive benefits of the same magnitude.

Additionally, in urban areas, there is evidence that a reduction in transportation costs can lead to an increase in women's labor participation, as well as an increase in real wages and a decrease in the wage gap between women and men.¹³

In rural areas, on the other hand, improved connectivity could increase agricultural productivity by almost 5%, because better access to markets (domestic and international) can lead to an increased use of modern inputs, and to the allocation of labor and land to crops with the greatest comparative advantage.¹⁴

Based on lessons learned from two evaluations of road expansions and improvements in Peru¹⁵ and Mexico,¹⁶ CAF's investment may have generated an increase in employment of about 5% in the areas benefited by the projects financed by CAF.



The Santa Cruz-Puerto Suárez road

- Was financed in part by CAF.
- Completed the connection of Bolivia's eastern and western borders, facilitating the transit of goods between Bolivia and Brazil.
- Improved the connectivity for populations along the road's route.
- **Resulted in an increase in real wages in both countries of between 0.3 and 0.5%,¹⁷ especially in the towns located closer to the construction of the new road section.**
- Had a negative impact on some localities because, as mentioned above, the roads' network structure means that the goods and services offered by these localities now face greater competition from those produced in the places connected by the new infrastructure.



Diversification of economic activity

The productive structure of economies could also change thanks to CAF's road investment, given that the increased access to intermediate and final markets, as well as the generation of productive clusters, could lead companies to specialize and thus increase their productivity.¹⁸

Access to more markets and/or greater agglomeration gives companies easier and cheaper access to productive inputs (domestic or imported), which leads producers to make a stronger commitment to the activities in which they have comparative advantages, such as manufacturing or services.¹⁹



Two studies²⁰ in Colombia and Argentina carried out for RED 2021^b of regional integration in LAC, found that road improvements could indeed drive a structural transformation of the economy toward a greater weight of manufacturing in both exports and employment. The participation of rural families in local agricultural production may decrease because now, with the new infrastructure, they can participate in other labor markets and earn better wages.²¹

Within the agricultural sector, improving roads can lead to specialization in the crop varieties with the greatest economic potential.²²

^b Report on Economic Development 2021.

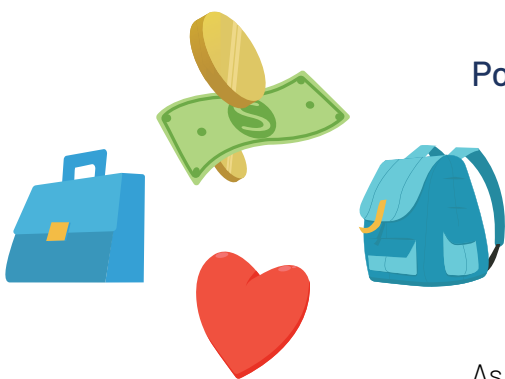
Size of economies

Evidence points to the fact that large-scale road investments can have a positive effect on the size of economies.²³



- Between 2006 and 2017, around US\$5 billion was invested to increase the Bolivian road network, doubling the extension of the country's paved roads. This effort led to an increase in GDP of around 0.5%.²⁴
- A similar increase in GDP was found in Ecuador and Paraguay.²⁵
- In Haiti, the paving works undertaken thanks to the foreign investment received after the 2010 earthquake generated a GDP growth of between 0.6 and 1.2%.²⁶
- There is similar evidence for the case of Nigeria²⁷ and India.²⁸
- A study in Colombia found that GDP growth occurred in the industry and services sectors, but not in agriculture.²⁹

Road investment—whether for the creation of new roads or the conservation and maintenance of existing ones—can also play an important role in economic recovery efforts, given its capacity to create direct and indirect jobs in the beneficiary localities: directly employed labor and increased sales for suppliers of raw materials, transportation, food, and lodging. In Latin America and the Caribbean, investing US\$1 billion in the water and sanitation, energy, and transportation sectors has the potential to create between 67,000 and 139,000 jobs.³⁰



Poverty

One of the main objectives of the road network is to connect the most remote areas in rural and urban areas to reduce their vulnerability through greater access to different markets and a broader range of public and private social services.

As mentioned above, it has been found that roads can help increase rural household incomes, per capita consumption, and wages and thus have the potential to reduce poverty.³¹

In urban areas, there is also evidence that the wellbeing of people living in more remote locations increases when they are provided with transportation to areas of the city with greater economic activity.³² In this regard, CAF's road investment could

CAF's road investment could help reduce poverty levels in the beneficiary areas.

help reduce poverty levels in the beneficiary areas. Not only does the investment lead to greater financial wellbeing but it also improves quality of life by facilitating the population's access to education and health services and increasing the ownership of durable assets.

Greater connectivity could also reduce the time that the members of some households spend working for others, which could free up time to work on their own agricultural activity, thanks to greater access to new production techniques and inputs, including labor supply from other locations, especially for rural households with more education and/or assets.

In the case of education, roads increase enrollment³³ and school attendance,³⁴ although these results depend largely on the educational offering in the connected localities or on the possibility of complementing road investment with investments in educational infrastructure and services.³⁵

Roads also contribute to improving the nutritional status³⁶ of rural families and potentially facilitate access to preventive health services.³⁷ However, as with education, these positive effects depend on the availability of health services or the existence of complementary investments.



Traveling the road to sustainable development

CAF's road investment directly contributes to Sustainable Development Goal (SDG) 9, by helping to increase the connectivity of rural areas and the volume of passenger and freight traffic.

Existing evidence further suggests that CAF's action on roads has the potential to indirectly affect:



Road interventions, therefore, would benefit the population and its wellbeing in an integral manner.

Enhancing the impact of roads

Selection of investment projects

As previously outlined, the benefits that roads generate for the localities that make up the network are influenced by the initial characteristics of their labor, goods, and services markets,³⁸ and even by the characteristics of the beneficiary households.³⁹ This is a very relevant reflection when deciding where to locate road improvements and how to complement them with investments in other areas that can enhance their benefits.

For example, when investments succeed in connecting localities with logistic centers, there are increases in income and living conditions in the most rural and poorest areas.⁴⁰ In other cases, however, those who benefit most are people with more education,⁴¹ more consolidated companies or localities with better initial market conditions or business and public services environment. These characteristics are more typical of relatively larger localities, so it would be these, and not the poorest, that would obtain the greatest benefits from road investment.

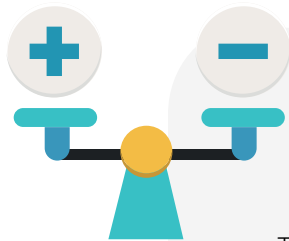
The impact of a road occurs mainly because it connects companies to supply markets that allow them to reduce production costs or give them access to new markets where they can sell their products.

It has also been found that the impact of a road occurs mainly because it connects companies to supply markets that allow them to reduce production costs or give them access to new markets where they can sell their products.⁴²

In agriculture, the benefits of roads depend on the availability of land in the connected locations. Greater availability increases the profitability of devoting more resources to agricultural activities. In turn, the existence of a robust agro-industrial sector facilitates the movement of labor from subsistence agriculture to the industrial sector with, potentially, higher wages.

It is important to note, however, that the potential benefits of this increased access may take longer to materialize when markets are younger and smaller.⁴³

Therefore, in the context of significant fiscal restrictions, both the social and economic benefits of each project must be prioritized when determining where to focus road investment. It is therefore important to evaluate road investments from an integral perspective. Some projects with a low economic return in the short term may be key in the long term for very vulnerable families to have access to a better quality of life and eventually overcome their poverty.



These considerations have led CAF to develop an index to prioritize projects according to their potential impact in different dimensions.

- The index has been used, for example, in a portfolio of IIRSA road and rail projects.^c This has created a pool of infrastructure projects identified with impact criteria that allows for a more structured dialogue with CAF member countries when planning financing requests for integration projects.
- This index, in addition to considering the potential of projects to minimize costs and travel times, also takes into account their integration potential (logistics, multimodal and intermodal), as well as the impact on the environment and future generations, the potential to adapt to innovations in road material, and the potential to reduce poverty.⁴⁴

^c Initiative for the Integration of Regional Infrastructure in South America.

Quality of road projects and their impacts

The quality of infrastructure projects is key to ensuring that they materialize and their benefits are sustained while minimizing costs and losses due to unforeseen events. According to estimates, better budgeting, permit management, or higher quality engineering designs⁴⁵ for infrastructure projects in Latin America and the Caribbean could generate savings of around 0.65% of GDP. The impact of infrastructure can be enhanced by strengthening implementation and governance throughout the project life cycle using cost-effectiveness, accountability, transparency, and integrity criteria. According to World Bank estimates, investment spending accounts for only about 8% of transport reliability, whereas governance accounts for 44%.⁴⁶



In 2017, CAF created the Programa de Pre-Inversión para la infraestructura de Integración Regional [Pre-Investment Program for Regional Integration Infrastructure (PPI)]. Through this program, the bank has supported road infrastructure planning and management processes with four technical cooperation operations, totaling almost US\$10 million in this period.

Road maintenance, on the other hand, is vital to ensure that the existing network is sustainable for an extended period in acceptable quality conditions. Lack of road maintenance generates costs that must be covered privately, due to the disruptions generated when infrastructure fails unexpectedly. In low- and middle-income countries, for example, the lack of maintenance of public infrastructure is estimated to cost households and businesses almost USD 400 billion per year.⁴⁷

Road maintenance is vital to ensure that the existing network is sustainable for an extended period in acceptable quality conditions.

A greater emphasis on maintenance can be even more favorable than investing in new infrastructure because it can increase employment, wages, and household consumption expenditures,⁴⁸ in addition to the savings generated by reducing unplanned outages. Similarly, maintenance is key to underpinning the resilience of infrastructure to shocks generated by climate change and environmental degradation. In recent decades, countries like Colombia, Brazil, Uruguay, and Peru, have managed more efficiently their roads by ensuring not only that the projects are built but also by guaranteeing the operation and maintenance of the infrastructure from the initial contracting of the works.



Nearly half of CAF's road operations approved in the last five years have allocated resources to road maintenance activities. In 2020, CAF approved financing of more than USD 300 million for the PROREGION 1 program in Peru, which seeks, among other things, the conservation of almost 5,000 km of roads for a period of five years with initial trafficability conservation activities, routine conservation by levels of service, and periodic conservation of roads and bridges.

Environment

Roads also generate costs in the areas connected by the new infrastructure and surrounding ones. In particular, environmental quality may worsen due to the deforestation needed to build or widen roads or higher pollution levels produced by heavier vehicular traffic.⁴⁹

Adequate road maintenance can help lower emissions by improving surface evenness, which in turn increases the efficiency of vehicle movement. Improving one-third of Europe's maximum capacity road network by 2030 could lead to savings equivalent to replacing 3 million conventional cars with zero-emission vehicles.⁵⁰ In this regard, there are important scientific and technological advances in the development of sustainable, automated, and intelligent materials.

To factor in the environmental dimension of road infrastructure, CAF:

- Developed a Road Infrastructure Quality Index to assess the degree of contribution to sustainable development of CAF's infrastructure projects.
- Published a guide with best practices for the adaptation of roads to climate change ([Guía de Buenas Prácticas para la Adaptación de las Carreteras al Clima](#)).
- Will publish a document on innovative and sustainable technologies for the construction and maintenance of rural roads, identifying best practices in the region and their social impact on the local population.
- Developed massive online training courses on sustainable roads and best practices in rural roads.
- Is studying pavement recycling and the circular economy based on the lessons learned in LAC.



In summary

The increased market dynamics made possible by roads has the potential to rise employment and income levels, production, and trade.

Roads, therefore, act as a backbone of the economy and society by connecting people and businesses to labor markets or input and output markets.

Greater connectivity can also improve the quality of life of households by increasing access to essential goods and services. It can also benefit businesses by generating greater agglomeration and facilitating access to critical logistical services to increase their competitiveness.

In recent years, CAF's support has been key to making these benefits a reality for thousands of people and companies throughout Latin America and the Caribbean.



References

- 1 [RED \(2021\)](#)
- 2 [Our world in data \(n.d.\)](#)
- 3 [AC&C \(2020\)](#)
- 4 [AC&C \(2020\)](#)
- 5 [IDEAL \(2017-2018\)](#)
- 6 [RED \(2021\)](#)
- 7 [World History Encyclopedia \(n.d.\)](#)
- 8 [RED \(2021\)](#)
- 9 [Hine et al. \(2016\) and limi, Lancelot, Manelici and Ogita \(2015\)](#)
- 10 [Volpe et al. \(2017\)](#)
- 11 [Freund and Rocha \(2011\)](#)
- 12 [Berg et al. \(2016\), Sotelo \(2020\) and Asher and Novosad \(2018\)](#)
- 13 [Velázquez, Daniel \(2022\)](#)
- 14 [Sotelo, Sebastian \(2019\)](#)
- 15 [Volpe et al. \(2017\)](#)
- 16 [Blankespoor et al. \(2017\)](#)
- 17 [RED \(2021\)](#)
- 18 [RED \(2021\), Blankespoor et al. \(2017\), Berg et al. \(2016\), Hine et al. \(2016\) and Melecky et al. \(2018\)](#)
- 19 [Quintero and Sinistierra \(2021\)](#)
- 20 [Baldomero-Quintana \(2022\) and Belmar and Gentile \(2021\)](#)
- 21 [Asher and Novosad \(2018\), Berg et al. \(2016\) and Shamdasani \(2021\)](#)
- 22 [Sotelo \(2020\)](#)
- 23 [Banerjee et al. \(2012\) and Roberts et al. \(2012\)](#)
- 24 [Policy brief \(2021\) and RED \(2021\)](#)
- 25 [Bolivar \(2021\)](#)
- 26 [Mitnik et al. \(2018\)](#)
- 27 [Ali et al. \(2015\)](#)
- 28 [Melecky et al. \(2018\)](#)
- 29 [Quintero and Sinistierra \(2021\)](#)
- 30 [Pastor et al. \(2020\)](#)
- 31 [Khandker et al. \(2009\), Bucheli et al. \(2018\), Ali et al. \(2015\), Berg et al. \(2016\), Hine et al. \(2016\), Charlery \(2015\), Fujita \(2017\) and Sotelo \(2019\)](#)
- 32 [Warnes \(2021\)](#)
- 33 [Berg et al. \(2016\) and Khandker and Koolwal \(2011\)](#)
- 34 [Hine et al. \(2016\)](#)
- 35 [Hine et al. \(2016\) and Bucheli et al. \(2018\)](#)
- 36 [Berg et al. \(2016\)](#)
- 37 [Banerjee and Sachdeva \(2015\) and Hine et al. \(2016\)](#)
- 38 [Melecky et al. \(2018\)](#)
- 39 [Velasquez \(2022\)](#)
- 40 [Bird and Straub \(2020\)](#)
- 41 [Bucheli et al. \(2018\), Khandker and Koolwal \(2011\) and Fujita \(2017\)](#)
- 42 [Baldomero-Quintana \(2022\)](#)
- 43 [Hine et al. \(2016\), Asher and Novosad \(2018\), Blankespoor et al. \(2017\) and Khandker and Koolwal \(2011\)](#)
- 44 [AC&C \(2020\)](#)
- 45 [Cavallo et al. \(2020\)](#)
- 46 [World Bank \(2021\)](#)
- 47 [World Bank \(2021\)](#)
- 48 [Chaurey and Le \(2022\) and Gertler et al. \(2022\)](#)
- 49 [Berg et al. \(2016\)](#)
- 50 [EAPA, EUPAVE and FEHRL \(2016\)](#)