

From Connectivity to Empowerment: Informing Resilient Transport Infrastructure Investments

Pakistan Country Brief | September 2025

Country overview

Themes: Development Corridors,
Climate, Gender

Coverage: Pakistan

Timeline: 2020 – Ongoing

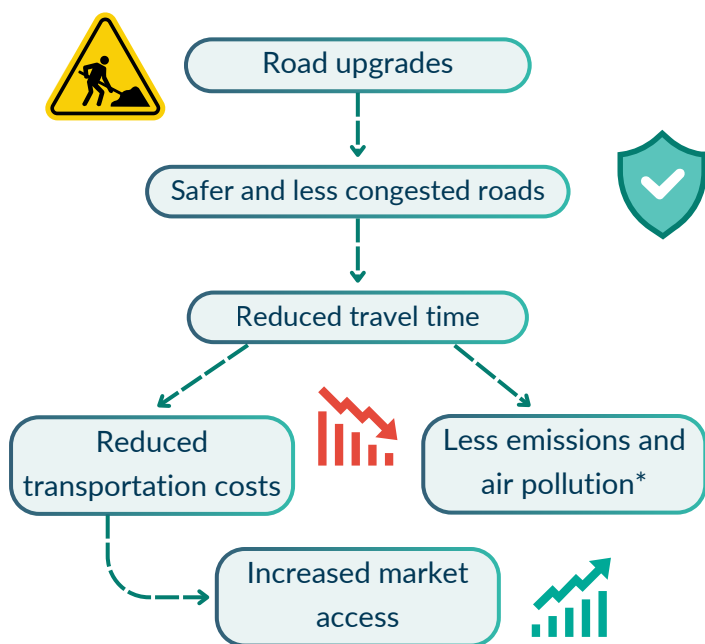
Introduction

ieConnect adopts a holistic approach to transport research and evaluation in Pakistan, with work focused on infrastructure and its relationship with economic activity and human capital. The team began working in the country by **assessing the comprehensive effects of major road investments**, which aim to integrate markets, reduce road accidents, improve trade, and drive economic growth. Building on this experience, ieConnect was positioned to actively **monitor the socio-economic and infrastructural impacts of the devastating 2022 floods in Sindh and Baluchistan**, providing vital analysis to support ongoing reconstruction and inform the design of climate-resilient infrastructure. Complementing the infrastructure-focused efforts, the team partnered with the South Asia Gender Innovation Lab, the Transport and Education Global Practice, and the Government of Pakistan to **address the gender gap in education by evaluating the provision of subsidized, safe transportation for middle school girls in Khyber Pakhtunkhwa**. The findings are expected to add scientific evidence on effective policies concerning mobility and safety of women and inform the scale-up of the intervention.



Measuring the Impact of Development Corridors

Following Vision 2025, Pakistan began prioritizing significant investments in transport infrastructure to improve welfare across all provinces. Addressing a critical challenge within the country's transport sector – a limited paved road network (5% of total roads) that supports 80% of all commercial transport – these infrastructure projects aim to bridge the gap and unlock the country's economic potential.



ieConnect is evaluating the effect of road construction on local economic activity and pollution. The team uses different data sources to conduct the evaluation:

- **Satellite imagery**, including daytime and nighttime lights, is used to infer air pollution and local economic activity at the ground level.
- **Survey data** to complement analyses relying on satellite imagery.

* Further investigation could determine whether reduced travel time decreases pollution or if the induced traffic will increase it.

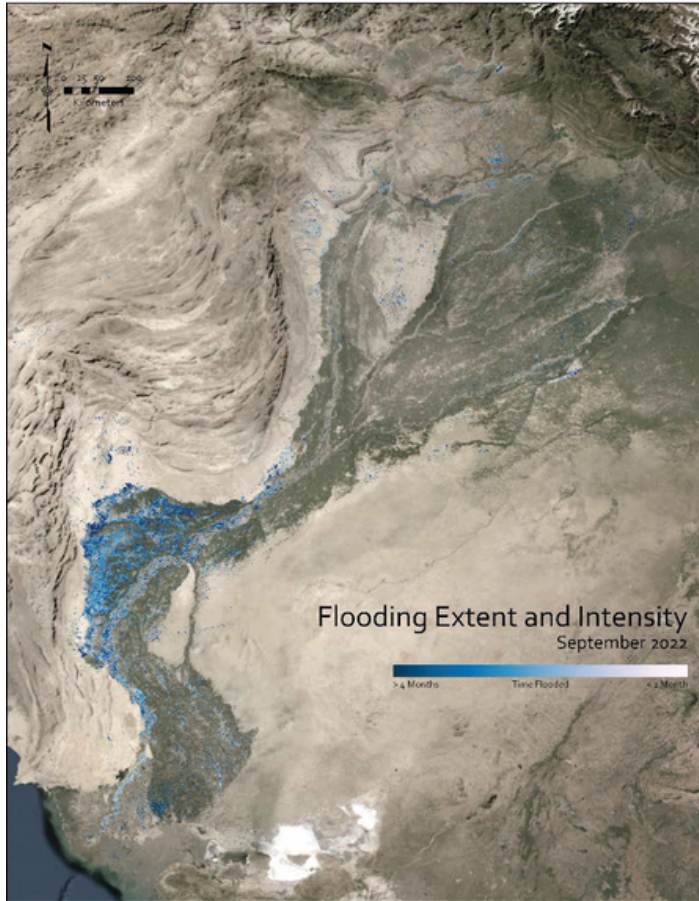
Mapping of road development and quality

A significant challenge in transport investments is the lack of accurate data on when and where road upgrades have occurred. Records are often incomplete, and implementation rarely follows initial plans. To address this gap, **the team used historic, high-resolution satellite imagery to map road upgrades across major roads in Pakistan since the early 2000s**, documenting the type of improvement (new road or additional lanes) and the type of road improved (paved or unpaved road). To create the dataset on historic road improvements, the team checked locations to document road upgrades. Because of the detailed manual task, the dataset obtained can be used as a highly accurate “truth dataset”. This data is valuable for training artificial intelligence (AI) models that can be taught to automatically identify and document road changes in satellite images, making the process faster and more efficient than manual checking. This innovative method for filling data gaps in transport investments could be a valuable tool in contexts with similar challenges.



Evaluating Damages and Recovery Efforts of the 2022 Floods

Between June and October 2022, severe flooding had devastating effects in the provinces of Sindh and Baluchistan, Pakistan. **The scale of the flooding resulted in significant human and economic losses.** Around 1,700 deaths, nearly \$14.8 billion in damages, and \$15.2 billion in economic losses were reported.



Source: Ipsos Risk Analytics/World Bank, September 2022.

The ieConnect team is conducting a study to understand the effects of the damage and **reconstruction efforts**, focused on road segment rehabilitation, irrigation infrastructure reconstruction, and water supply reconstruction. Using various big data sources, **the evaluation assesses the impact of the floods on market access due to road damage, with subsequent reductions in economic activity.** The data sources used in this study can facilitate observing the impacts and recovery efforts of natural disasters and leverage previous studies on corridors in Pakistan.



Nighttime lights have become a common proxy for economic activity. The team developed R and Python packages to convert VIIRS Black Marble datasets, provided by NASA, into an analysis-ready format.



Map box movement data is an activity index derived from mobile phone data used to show the presence of people in different locations during and after the floods.



Google Open Building datasets show building presence and building height at a 4m resolution annually, starting in 2016.

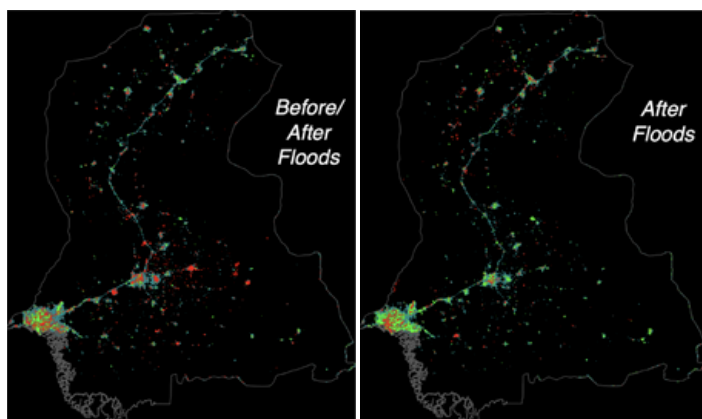


Analyzing the impacts of the floods

The team observed changes in transport infrastructure and socio-economic activity before, during, and after the floods.

Nighttime lights allowed the team to compare activity in cities affected the year before and right after the floods occurred.

In Figure 1, the image on the left shows a significant reduction of activity during 2022 (marked by the red spots), and the image on the right suggests that recovery efforts increased nighttime lights.



Decrease Increase No change

Google Open Building data showed a decrease in building heights from 2021 to 2023, which can help identify major damage from floods on this type of infrastructure.

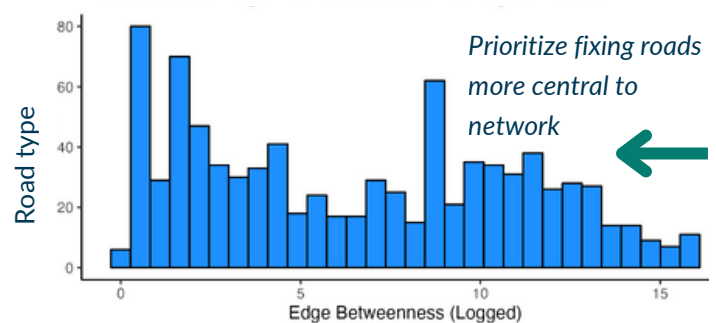
A similar analysis was conducted on roads, where a decrease in the activity of a certain road can help identify which roads are damaged. Although some of the roads that show less activity are not necessarily damaged, the analysis supports more efficient identification of damaged infrastructure when coupled with other data sources.

The Map Box Activity Index, combined with the building data, showed how people left residential areas in large numbers. However, slight increases in people's activity were evidenced in buildings such as hospitals and commercial areas.

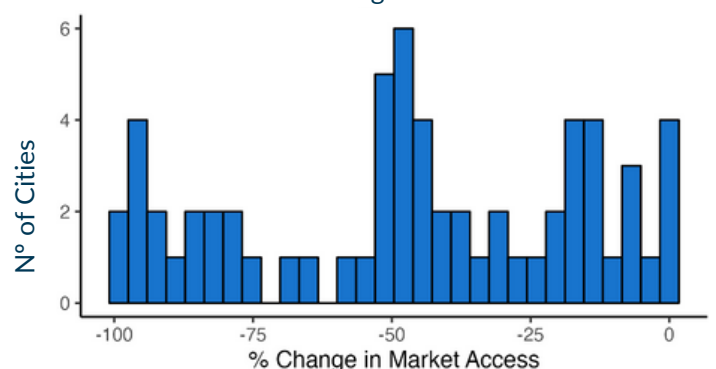
Changes in market access were distributed evenly across different areas, but certain regions experienced substantial reductions. Some locations experienced up to a 100% decrease in market access.

The analysis examined the importance of roads within the network and compared the distribution of importance between damaged and undamaged roads, finding that damaged roads tended to be more important to the overall road network. This analysis can be used to prioritize roads in reconstruction efforts and suggests that fixing even a few key roads can lead to large gains in improving market access and boost economic recovery efforts.

Distribution of Edge Betweenness of Damaged Roads



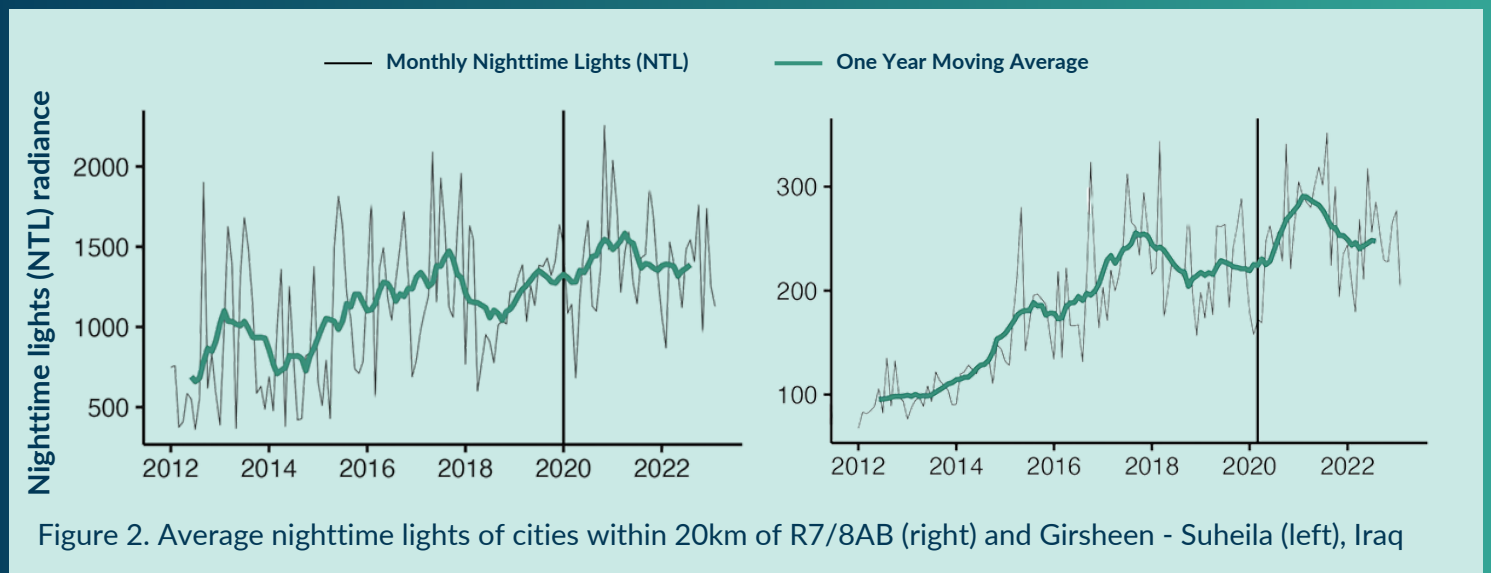
Distribution of % Change in Market Access



ieConnect Geospatial Impact Evaluations in Fragile Settings

Drawing on similar approaches used to evaluate recovery efforts in Pakistan, ieConnect conducted an impact evaluation in Iraq to assess road investments in Iraq's Expressway 1 and a new corridor between Girsheen and Suheila. Considering the challenges of collecting traditional survey data in the country, the team relied on big data sources to measure changes in infrastructure use and economic activity.

The evaluation used nighttime lights satellite imagery as a proxy for local economic activity, alongside GPS mobility data and radar satellite imagery (SAR) to track road use and congestion. Applying an event study design, the evaluation found an increase in road users on both corridors after the investments. While the influence on broader economic activity was not yet apparent at the time of the evaluation, the use of these alternative, big-data sources effectively demonstrated changes in mobility and road utilization, paralleling methodologies used to evaluate road construction impacts and flood recovery efforts in Pakistan.



Improving girls' education through subsidized transportation

Leveraging a partnership with the South Asia Gender Innovation Lab, the Transport and Education Global Practice, and the Government of Pakistan, **ieConnect supports an impact evaluation seeking to address the relationship between safe and affordable transport and access to education**, school attendance, retention, safety and female empowerment. **The team will evaluate the provision of subsidized transportation to girls eligible for middle school.** The subsidized transport involves recruiting privately run vehicles with drivers vetted by the Government and Parent-Teacher Councils (PTCs), who are committed to ensuring safe transportation.

The intervention is designed to address three dimensions of barriers to girls' education:

- **Affordability:** alleviating the economic cost of travel.
- **Accessibility:** ensuring a reliable mode of transportation is available.
- **Safety:** ensuring only vetted drivers and other female passengers travel together.

Data collection includes

A baseline survey completed in May 2024 (interviewing caregivers, teachers, transport providers, PTCs, and collecting school records)

Two follow-up surveys (a phone tracking/early outcome survey and a later in-person survey, possibly including girls and collecting learning data)

An endline survey (interviewing eligible girls, parents, PTC members, female teachers, female chaperons, and transport providers).

The study is designed to provide scientific evidence on effective policies in remote contexts, particularly when alternatives like bicycles are not feasible. The results and recommendations from the evaluation will be used to inform the scale-up of the intervention in other districts and scaling up the program in similar contexts internationally.

The ieConnect for Impact program is a collaboration between the World Bank's Development Impact group and the Transport Global Practice. This program is part of the Development Impact Fund (DIF) multi-donor trust fund and is funded with UK International Development from the UK government and the European Union (EU). For more information about the ieConnect for Impact Program, visit the [ieConnect Webpage](#) or contact ieconnect@worldbank.org.



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