Chicamocha Canyon Colombia 2017. Adam Cohn

Factsheet Resilience Solutions for the Road Sector in Colombia

This Factsheet is a part of the Private Markets for Climate Resilience (PMCR) project to evaluate systematically the potential market for climate resilience solutions in the private sector. Focusing on agriculture and transportation, current practices and opportunities highlight products, services and finance in six emerging markets — Colombia, the Philippines, South Africa, Nicaragua, Kenya, and Vietnam.

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Road sector in Colombia

The Colombian road network consists of approximately 206,700 km, of which over 9% are part of a primary network managed by the national government, with the remaining 91% administrated regionally. Approximately 54% of the primary network is administrated by private sector concessions. Currently, the 4th Generation (G4) road projects, which include both reparation of old roads and construction of new roads, represent a new generation of road concessions with a much greater involvement of the private sector in road network design, construction, management and operations. In addition, G4 projects represent a perfect opportunity for public-private partnerships mainstreaming climate resilience, particularly in new development areas.

In the road sector, there is a solid understanding of the challenges related to the country´s geography and climate variability. The difficulty has been incorporating that knowledge into realistic budgets as well as ensuring accountability on the expenditure of allocated budgets. The G4 projects present an opportunity to overcome many challenges and invest in innovation to explore alternatives for ensuring safe and efficient roads in the country.

The Colombian public sector, supported by international cooperation agencies, has invested considerable efforts in creating awareness about climate change, both mitigation and adaptation. As a consequence, national agencies have realised the importance of including weather risks in road infrastructure development, with programs created directly to address climate risks. As an example, the sector's adaptation plan states that all environmental impact assessments of new projects should include a climate change assessment. Despite such efforts, private stakeholders in the sector remain largely disengaged and unaware of the relevant topics related to climate adaptation and resilience.

There are various challenges in the sector, including project delays and cost overruns due to prolonged community consultations and stakeholder agreements, lack of adequate and patient funding, and rigid contract conditions, among others. Moreover, the lack of a clear strategy and model that addresses the problems relating to the sharing of risks and economic impacts among project stakeholders.

Sector facts (2018)

Road network size: The national road network extends to approximately 206,700 km, of which 19,300 (9%) km are primary roads, 45,100 km (22%) are secondary roads managed by local department governments, and 142,300 km (69%) are tertiary roads managed by local department governments and municipalities.

Sector size, contribution to the country economy: 4G construction is estimated to contribute 0.5% annually to GDP. Once the roads are finished, the annual contribution to the economy is expected to rise 0.19%. All companies bidding for 4G construction are large companies. The total estimated investment is approximately USD 17 billion. Sub-contractors and material providers are mostly medium size although there are some SMEs –35% of SMEs involved on the overall infrastructure sector provide consultancy services.

Puente Pumarejo. JL Castiblanco

For a list of references, see the References Section of the PMCR Report.

The road sector - processes, activities and actors

Below are presented the main decision processes, activities and actors in the Colombian road sector.

	Decision to build a road	Feasibility study	Design	Project adjudication	Construction	Service & Maintenance
Activities	• Stakeholder agreement (agencies) • Selection of construction area • Dialogue with local stakeholders • Idea of road path	• Environmental studies • Road path considerations • Settlement & production areas • Community engagement • Selection of materials	• Technical assessments • Design of road project	• Tendering process • Review of proposals • Granting contract • Land acquisition	• Project set-up: camp, offices, land movement, building structures, drainages, bridges, etc. • Road construction	• Project set-up: camp, offices, land movement, building structures, drainages, bridges, etc. • Road construction
Direct actors	Ministry of Transport & National Infrastructure Agency	Ministry of Transport & National Infrastructure Agency	Ministry of Transport & National Infrastructure Agency	Ministry of Transport & National Infrastructure Agency	Auditors	Auditors
		Nacional Agency for Environmental Permits ANLA	Nacional Agency for Environmental Permits ANLA	Nacional Agency for Environmental Permits ANLA	Nacional Agency for Environmental Permits ANLA	
		Private companies, consultancies, contractors, service providers – Design, construction & maintenance	Private companies, consultancies, contractors, service providers – Design, construction & maintenance	Private companies, consultancies, contractors, service providers – Design, construction & maintenance	Private companies, consultancies, contractors, service providers – Design, construction & maintenance	Private companies, consultancies, contractors, service providers – Design, construction & maintenance
			Financial institutions & funding programmes	Financial institutions & funding programmes	Financial institutions & funding programmes	Financial institutions & funding programmes
Indirect actors	Communities & transport service providers	Communities & transport service providers	Communities & transport service providers	Communities & transport service providers	Communities & transport service providers	Communities & transport service providers
						Road users

Normal environmental conditions for operations

• High variability in the country's topography dominates local weather and climate conditions.
• Temperatures range between -4°C and 40°C, depending on the region and altitude.
• Precipitation also varies regionally with maximum annual rainfall reaching up to 10,000 mm.

Changes in weather and climate conditions that could affect operations

• *Landslides* are the most common event impacting the operability of the road network, followed by floods. An estimated 45% of the road network is extremely vulnerable to *floods*.
• In the Andean region of the country, the road network is affected by landslides, floods, structure collapses and erosion. Deforestation further aggravates the negative impacts of weather events.
• Along the Caribbean region, *sea-level rise* is a concern, as an estimated 45% of road networks are extremely vulnerable and 5% moderately vulnerable.
• In tropical regions, such as the Orinoquia region, *temperature increases* put significant pressure on roads paved with asphalt, resulting in subsidence and undulations. There is also risk of forest fires and flash floods.

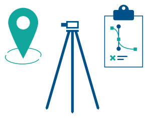
Main climate-related impacts affecting the value chain

• All main decision processes, including construction and operations, are affected by climate variability, extreme weather events and climate change impacts, including increase in temperature, changing precipitation patterns, extreme events and sea-level rise.

"I cannot store roads, so during the rainy season I make sure my operations and logistics departments are tuned in with IDEAM´s weather forecasts and early-warning systems."
Gabriel Molina, Incoasfaltos

B*Resilient Process Model

Each decision process of the road sector was assessed using the B*Resilient Process Model (BRPM), in order to identify the climate risks associated with each phase and the resilience options and tools available to address these risks, as well as to achieve specific resilience outcomes. The BRPM analysis of the **design process** is presented below.


Resilience outcome	**Designing a climate resilient road**		
Process Design	**Phase I** **Selecting road path**	**Phase II** **Road design**	**Phase III** **Budget**
Risks	Rainfall variability Landslides and floods	Climate risks not considered adequately in the design	• Potential delays and additional costs due to weather & climate extremes
Actors	Local & national authorities, Works Department, Contractors & consultancies, Private land owners		
Options & Tools	Technical assessments, Soil classification/ analysis & topographic assessments Environmental Impact Assessments Policy & regulations assessment Historical records, risk areas, Accidents dataset Location of farms and protected areas Community socialization	Road construction norms & regulations Sewage systems considerations for extreme weather events River & streams crossings designed to function during extreme events Management of slopes and drainag-es, consideration of landslides Material selection & construction criteria	Project timetable and budget, financial contingencies Environmental license Risk register Software Expert audits

Coastal erosion impacting roads along the Colombian Caribbean. Km 19 Cienaga-Barranquilla. Carmen Lacambra

“The Disasters Risk Management Unit has produced guidelines that we welcome everyone to use in the design of infrastructure projects, and to analyse and assess risks in intervention areas, including those related to climate changing conditions.”
Martha Ochoa,
Disasters Risk Reduction National Office

Resilience solutions

Identified resilience solutions in the road sector in Colombia involve various strategies that target primary roads managed by private-sector companies. Identified resilience solutions vary from *knowledge services* to *climate-resistant materials* and *capacity building*.

Leading resilience solutions: *Resistant construction materials (permeable pavement, bio filters, etc.)*

Resistant materials – Recycled Tire Rubber (RTR)
Recycled Tire Rubber (RTR) has been used in the production of asphalt since 1960. RTR is used as an asphalt binder modifier and asphalt mixture additive in gap graded and open graded asphalt mixtures and surface treatments. The principal component of RTR are waste tires. RTR is more resistant to extreme temperatures and less degraded by water, featuring reduced cracking in the roads, when compared with traditional materials. RTR is lighter coloured, making it less susceptible to heat absorption from solar radiation, minimising the urban heat island effect and contributing to roads with longer lasting pavement and reduced maintenance costs. Unlike other loose-fill driveway materials, recycled asphalt aggregate will bond together when compacted, allowing for a semi-permanent road surface that remains in place and minimises dust and dirt.

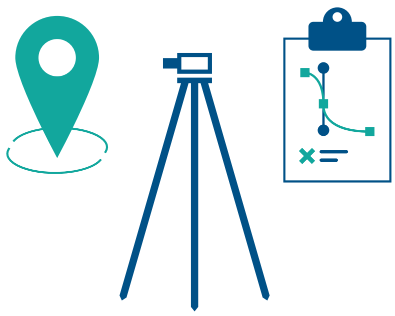
Resilience contribution: RTR has been identified as an alternative material for road construction that can provide climate resilience benefits and extend the life and resistance of roads.

Opportunities

• National agencies are realising the importance of including weather risks in road infrastructure development, with programs created directly to address climate risks.
• National plans to build, repair and maintain 8,400 km of roads provides an opportunity to introduce RTR in new roads.
• Upgrading transport infrastructure to increase regional competitiveness represents an opportunity for innovation.

Advantages of the resilience solution

• The use of RTR asphalt is a win-win adaptation and mitigation solution. RTR is environmentally responsible, given that asphalt is not a biodegradable material. In addition, non-renewable resources, including fossil fuels, must be used to generate virgin asphalt. It is much more environmentally responsible to choose a material that minimises waste by re-purposing old asphalt. Plus, the reuse of used tires substitutes the disposal of a large amount of waste, with less negative environmental impact, when compared with burning used tires.
• Roads paved with virgin asphalt have also been blamed for the urban heat island effect. The lighter coloured RTR is less susceptible to heat absorption from solar radiation and hence, contributes less to the urban heat island effect.
• Local and national government authorities have created incentives so that companies building and refitting the roads are motivated to use RTR materials. Companies building with these materials will have higher scores in the tendering process.



Tires discharged with no control. Carmen Lacambra