Ysalina Bridge, Cagayan de Oro. M.E.A. Lucas

Factsheet Resilience Solutions for the Road Sector in the Philippines

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 the Philippines

The Philippines, an archipelagic nation with more than 7,641 islands, relies on transportation systems involving road, water, air, and rail networks. Despite its unique island geography, which could give water transport a more significant role, road transport dominates the system, representing 98% of passenger traffic and 58% of cargo traffic.

Estimated damage to infrastructure from natural disasters during 2006-2015 amounted to USD 1.64 billion, driven by an increase in extreme climate-related events in recent years. Philippine roads are notorious for being perennially in need of repair and rehabilitation, especially after flooding, landslides, strong rains and tropical cyclones. In the context of climate resilience, the need for quality infrastructure goes beyond whether roads are paved or not. Adaptation strategies that strengthen networks and decrease their vulnerability to climate impacts appear to be the best approach to ensuring climate resilience in the country's transport infrastructure.

Because the Philippine transport sector is largely government-driven, a strong policy and governance environment will be critical for adequate adaptation strategies. However, climate resilience does not seem to figure significantly in government-led infrastructure programs, such as the current government's infrastructure program called Build, Build, Build!, which is projected to invest around USD 160-180 billion by 2022. Moreover, requests for proposals or bidding specifications in government infrastructure projects rarely require such climate-resilient solutions. In this kind of weak climate policy environment, the private sector tends to take on a mind-set that climate-proofing infrastructure is more expensive, and therefore an unnecessary cost.

Sector facts

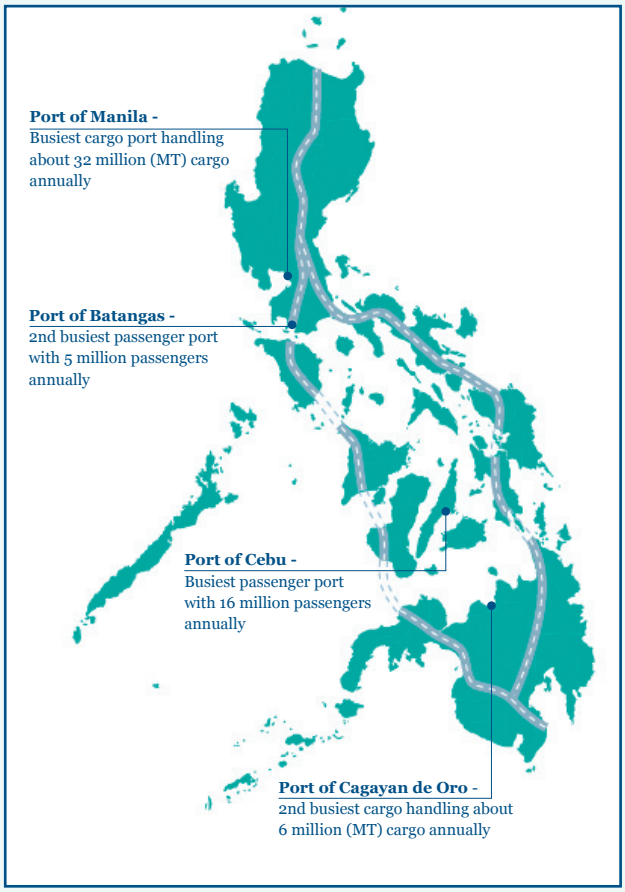
Road network size: Approximately 215,000 km of roads, of which 16% are classified as national roads and 84% as local roads. Out of the 33,000 km of national roads, 96% are paved (31% asphalt and 69% concrete) and the remaining 14% are unpaved (gravel or dirt).

Sector size, contribution to the country economy: While in terms of extent, per capita and GDP size, the Philippine road network is at par with many neighbouring countries, it lags in terms of quality. This is largely due to poor and inadequate maintenance.

> *"In terms of resilient infrastructure, we have to quantify resilience first because of the multi-hazards that we are experiencing now".*
> ***Cebu Provincial Office (provincial government)***

Philippines

7,641 islands - linked by 215,000 km of roads and 1,300 ports



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 Philippines road sector.

	Assessment & Planning	Analysis & Selection	Design & Development	Contracting & Building	Operations & Maintenance
Activities	• Feasibility studies of roads expansion • Project identification and planning	• Arrange funds for project • Bidding process for project	• Detailed design of roads • Procurement	• Construction of road	• Operation of road (e.g. toll fee collection) • Periodic maintenance of road
Direct Actors	**Government agencies, Private companies and contractors, Public-private partnerships, Research institutes and academia.**				
Indirect Actors	**Local communities, Landowners, Users, Input and service providers, Financial institutions, and Media.**				

Normal environmental conditions for operations

- Mean annual temperature (1981-2020): 27.5 °C
- Annual average rainfall: 960 mm to 4,105 mm
- Annual average number of tropical cyclones: 19-20

Changes in weather and climate conditions that could affect operations

- Flooding, repeated or long-term inundation of low-lying areas, especially from run-off
- Sea-level rise and storm surge
- Increased frequency and severity of tropical storms and cyclones
- Increased temperature variability, especially high temperatures
- Landslides, slope failures and other damage to roads

Main climate-related impacts affecting the value chain

- Infrastructure damage has a significant impact on the connectivity of the key economic value chains, such as producers and markets.
- Increases in operational, maintenance and repair costs of damaged infrastructure put increasing pressure on already-constrained national infrastructure budgets.
- Increased health and safety risks of operations, operators and users.

Greatest opportunities in the sector

- Improvement of transport infrastructure leads to economic growth through connectivity to local and global supply chains
- Increased resilience of both urban and rural communities to confront high vulnerability to extreme weather events and increasing climate change impacts
- Job creation and increased economic activity

Challenges

- Poor quality of the national transportation system, particularly road networks, and poor intermodal integration with water, rail and air transport systems
- Weak sector governance, institutional capacity, and financial constraints
- Limited private investment in transport infrastructure
- Limited and inconsistent implementation of regulations and frameworks in the transport sector

> *"Institutionalization and partnerships are important for the success of long-term projects."* ***Iloilo City Environment and Natural Resources (CENRO) (municipal government)***

M.A. Velas-Suarin

B*Resilient Process Model

Each 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 summarized BRPM analysis of the **Design and development, Contracting and building** and **Operations and maintenance** processes is presented below.

Resilience outcome	**Climate resilient road infrastructure**		
			
	Phase III **Design & Development**	**Phase IV** **Contracting & Building**	**Phase V** **Operations & Maintenance**
Risks	*Erratic weather events* that lead to flooding, increase in drainage, infiltration and hydrodynamic pressure of roads, decrease in soil cohesion, landslides, slope failures, damage of infrastructure and facilities *Increased temperature variability*, high temperatures leading to breakage of soil, softening or cracking of roads Storm surge and *sea level rise* leading to repeated or long-term inundation of low-lying areas and coastal erosion		
Actors	Government agencies & authorities Private companies & consultancies	Government agencies & authorities Private companies, consultancies & contractors	Government agencies & authorities Private companies & operators Road network users
Options	Climate-resilient structural designs	Climate-resilient materials in construction	Maintenance of structural integrity of infrastructure Re-evaluation of design to account for climate change
Tools	Update of current design manuals Appropriate budgets to account costs ensure climate resilience of infrastructure Incentives for making design climate resilient	Appropriate financial planning, financial instruments (e.g. insurance) for climate-related events during construction Financial incentives for investments in climate resilient infrastructure	Update of current operational manuals Regular quality checks Regular user surveys on infrastructure performance

"Integrating climate resilience at first is an additional cost... who is to say that that is really effective in the long run? Someone has to do a test case, a pilot project. If they are willing to do it, then it's well and good... We can't fight nature. All we can to do is to prepare."
International Builder's Corp. (IBC) (private contractor)

M.E.A. Lucas

Resilience solutions

The **leading resilience solutions** identified in the road sector in the Philippines are *climate resilient construction materials and technologies*. Two examples are *Geofoam*, a geotechnical material, and *coconut coir-based products*, such as geotextile nets.

Geofoam

EPS Geofoam has usually been applied as ground fill to reduce stress or loads imposed on the underlying soil or adjacent soil and structures. There are a number of benefits from the use of geofoam in road construction. Geofoam installation does not require a significant labour force or special equipment, and can be easily moved. It is a strong lightweight and low-density cellular plastic material with the weight equivalent of approximately 1% of regular earth fills or soil, and less than 10% of other lightweight fill alternatives. Another benefit that directly relates to schedule and climate resilience is that installation is unaffected by exposure to ongoing weather events like storms, as it does not wash away, thus saving time and money. Geofoam has a wide variety of applications such as road construction, particularly in soft-ground areas, slope stabilization and retaining walls, bridge abutment, foundation fill, and utility protection.

One of the main constraints to the large-scale uptake of Geofoam is that it is expensive compared with traditional materials. Currently, there is no local production so any material used must be imported. Adding to this, the material is made of plastic and is inflammable. Therefore, investment for protection against fuel spills is needed. Given the major barrier, private actors consider the application of Geofoam as an additional production cost rather than an investment in resilience. This problem is further aggravated by the lack of project specifications requiring the use of climate-resilient construction materials.

Resilience contribution: Although evidence is still limited, the use of Geofoam is expected to reduce damages caused by extreme weather and climate events, including costs and disruptions in supply chains and distribution networks.

Opportunities: The market for local production is still unexplored. Nonetheless, initial uptake is being seen in the private sector as well as the government. For example, Geofoam is being used in new embankment projects led by the government. There are no policy restrictions or impediments to using Geofoam in government projects. However, current project specifications in government projects do not require it. Updating government regulations and project specification would significantly contribute to the large-scale uptake of Geofoam, and similar materials, as climate resilience solutions for the road sector.

> *"Private sector actors are not (yet) ready to embrace climate resilience because it is an "added cost"... (but they) could go the extra mile, if there were government subsidies or tax rebates... (these companies) are not violating anything because we are following the minimum standards."*
> ***Private contractor***

Coconut coir-based products

Coconut coir-based products are bioengineered construction materials and technologies that are proven to prevent rain-induced landslides, soil erosion and sedimentation, and to reinforce slope mitigation. Coir-based products include geotextile nets, such as coco nets, and coco logs and peats. The coco-net bioengineering solution uses live plants along with dead or organic materials, such as those made of coconut fibres. Coconut husks are harvested or collected, then decorticated and de-fibred. The fibres are then stockpiled in preparation for twining and weaving into nets according to desired sizes. The installation of these products involves laying out rolls of nets, in overlapping patterns, and fastening them with stakes.

The use of coconut coir-based products in road construction benefits from biological, ecological, and engineering principles to develop living and functioning systems that can help in strengthening slopes and mitigating or preventing erosion and sedimentation, while still allowing nature, plants and vegetation to thrive. The products are 100% biodegradable and resistant to UV degradation, and can last 2-3 years, upon which vegetation would have taken over soil control. The materials have both high water-absorption capacity and resistance to high water velocities.

The materials are substantially cheaper compared with similar solutions and installation does not require a high level of labour skill. However, there is a risk of fire, especially if installed during the warm months, and periodic maintenance is required to ensure that vegetation has taken over as expected. For the solution to be most effective, the material application requires thorough planning and preparation. Stability assessments also need to be taken into account, including hydrology, seismicity, choice of vegetation, etc.

Resilience contribution: The main resilience contribution is the prevention of disruptions in the road network due to weather events, particularly landslides and floods. Moreover, immediate erosion control can be achieved, while waiting for vegetation cover to be firmly established.

Opportunities: While the use of the solution in roads is still very new, the use of coco net technology is widespread, and markets exist both locally and abroad. In the context of strengthening soil erosion control, the government is actively supporting the large-scale uptake of the solution. Moreover, the solution enjoys community support as it generates jobs and has strong environmental protection features.