Climate-Proofing Timor-Leste's Roads

By Chen Chen and Maria Christina Dueñas

- **When conducting climate change assessments, identify climate change parameters that are most important to a project from the onset.**
- **To counter inherent uncertainties in mathematical models, adopt an integrated "top-down" and "bottom-up" approach to climate change assessment.**
- **Small investments to climate-proof road projects can lead to substantial savings in future rehabilitation costs.**

When climatic changes impact roads to the point that their closure or threatened disappearance becomes commonplace, climate change risks should logically be considered in a rehabilitation project. In a pilot, this is just what Timor-Leste and the Asian Development Bank (ADB) are learning to do.

Background

Timor-Leste's severe climate—with droughts, floods, and strong winds among them—has always been the biggest enemy of its roads. With road closures, landslides, land degradation, and sedimentation often resulting from climatic events, it is no wonder that almost the entire road network of Timor-Leste badly needs rehabilitation.

In 2009, ADB approved the Road Network Development Sector Project to, among other things, rehabilitate 230 kilometers of national roads and develop a road maintenance program.

Typical of ADB projects, a period of extensive study and design took place to ensure that the project results meet Timor-Leste's needs and expectations. Midway through the project preparatory technical assistance, the project team realized one thing: climate changes, if ignored, might damage their project investment.

The project includes Timor-Leste's coastal roads and those passing through highly mountainous, interior agricultural areas. Both road types are vulnerable to changes in precipitation and the intensity of storms and rainfall. Also, coastal roads risk flooding due to rising sea levels. Since climate changes will impact these roads differently, measures to reduce their vulnerability should also differ. To zero in on the best measures for protection, the project design team conducted a climate change assessment.

Challenges

The first hurdle was getting stakeholders to understand the need for this assessment. How can climate changes impact roads? Why should Timor-Leste be concerned with adaptation measures when it is not even a significant contributor of greenhouse gas emissions? These were just two of many questions raised. Numerous dialogues helped stakeholders realize and accept that climate change adaptation is a universal concern.

Chen Chen

Timor-Leste road destroyed by flooding

Another challenge was finding the right climate change specialist to join the project team, which included road engineers, geotechnical and environmental specialists, construction specialists, and a transport economist. While climate change has gained wide recognition in recent years, the supply of practitioners able to design climate-proofing infrastructure projects has not kept pace.

The biggest challenge, however, was finally integrating the results of the climate change assessment into the work of other team members and overall project design. It took a month of reviewing and reconciling outputs to get this done.

Approach

Discovering What Changes are Expected. The first step was to assess projected climate changes in Timor-Leste. Project engineers had earlier identified peak rainfall as the most important climate parameter in road engineering and that became the focus of the analysis together with the following:

- change in onset and intensity of seasonal rains;
- changes in very hot days and heat waves;
- expected sea level rise;
- changes in intensity and frequency of precipitation events and flood patterns;
- changes in seasonal precipitation and flooding patterns; and
- changes in cyclone intensity, frequency and duration, and associated storm surges and wave actions.

Knowing full well the inherent uncertainties in predicting climate changes, particularly for a data-poor country such as Timor-Leste, the assessment took on multiple methodologies—from top-down approaches (e.g., downscaling of global and regional mathematical models of climate change, analysis of historical data for Timor-Leste) to bottom-up methods (e.g.,

focus group discussions, community-based surveys, field observations on climate changes, and coping mechanisms).

Discerning Climate Impact Links. Some of the assessment's findings do not bode well not only for Timor-Leste's road infrastructure but also for its communities.

For instance, temperature is expected to increase, with hot days and heat waves becoming more frequent. These would usher in repeated and intense precipitation events, i.e., wet storms, which could result in increased flooding, due primarily to inadequate drainage systems.

The flooding will exacerbate erosion, already a serious problem in Timor-Leste because of its steep topography, and this will likely lead to bigger loads of sediments going into the drainage systems. Flooding could also saturate the pavement, embankment, and subgrade materials, leading to structural failure.

Sea levels are expected to rise in the 21st century, and so will the probability and intensity of extreme wave heights. This could mean flooding and wave damage for low-lying coastal areas, damaging the road infrastructure through erosion of the embankment or saturation of the pavement.

Beyond these physical impacts on road infrastructure, climate changes may also impact the economic and social environment. For instance, the fluctuating temperature, precipitation, and availability of water could alter agricultural systems, leading to changes in the volume and types of traffic.

Results

Based on assessment results, the project team proposed the following engineering and bioengineering adaptation measures, among others:

- constructing earth levee banks with rip-rap protection for roads at risk of erosion from extreme waves;
- providing larger drains and additional culverts to accommodate the larger quantities of runoff;
- re-forestation or re-vegetation on unstable slopes, e.g., planting around 500 trees per hectare; and
- applying vegetated erosion control blankets, which consist of natural fibers able to retain soil and sediments.

Liza Leclerc

Rip-rap protection for roads at risk of erosion

The project cost will increase by about 10% with these climate-proofing measures. But there is no denying that the measures strengthen the project design. Because of the climate change assessment, the 230 kilometers of roads to be rehabilitated by the project will be less vulnerable to the impacts of climate change. Beyond that, it will also not harm nor increase the vulnerability of their surrounding regions and will provide added co-benefits to surrounding communities. As the project team surmises, small investments to climate-proof road projects can lead to substantial savings in future rehabilitation costs and contribute to poverty reduction at the same time.

Project officers and climate change specialists in the Environment and Safeguards Division of ADB's Regional and Sustainable Development Department are now working together to develop a step-by-step guide on climate-proofing infrastructure projects. Since the world is already experiencing, and will continue to experience, the impacts of climate change, their hope is to make climate change assessments more readily doable and, eventually, mainstreamed into project designs.

For further information, contact
Chen Chen, Infrastructure Specialist (cchen@adb.org); Maria Christina Dueñas, Knowledge Management Officer (cduenas@adb.org), Asian Development Bank.

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