CARE for South Asia

Climate Adaptation and Resilience for South Asia Project

Volume #5 | October 2022

Interview with Prof. Adolf Ng, Academic and Chief Editor of The Maritime Economist

Paving the Way for Resilient Roads: *the Secret Lies in Proper Planning*

Safety and Sustainability First: *the Roadmap to Climate Resilience*

Business Leaders of Resilient Roads and Reasoning

The CARE for South Asia project is a partnership between ADPC, RIMES, and the World Bank to support informed decision-making for protecting development gains in South Asia

Dear Readers,

Transport sector is often overlooked regarding climate change, but it shouldn't be. When disasters strike roads, rails, bridges and ports, then there is a loss of connectivity and people's exposure to risks are doubled. First responders and food/medicine supplies cannot reach those who require it because of flooded and damaged roads, which in the long-term hurt community economies and development. Although the transport sector is one of the major contributors to global carbon emissions, it is also the sector most impacted and at-risk due to climate extremes and stressors.

In the 5th issue of the CARE for South Asia newsletter, we take off with a discussion on how climate change impacts all forms of transport from sea, air and land with Prof. Adolf K.Y. Ng, Academic and Chief Editor of The Maritime Economist. Next, we join our ADPC Transport experts on a learning journey about incorporating climate-resilient data and decisions into road planning, the role of low-volume roads in sustainable development, and transport resilience.

Don't miss the global business leaders who are reshaping perceptions and resilient transport initiatives, nor the various innovations being implemented and supported under the CARE for South Asia project, such as near-real-time monitoring of road and power infrastructure using advanced geospatial datasets.

We are also excited to share new additions to our 'Cli-Fi' and 'Breaking the Jargon' sections, which blur the lines between fantasy and reality in one instance and give clear answers to the questions you may have about climate change terminologies.

We plan to bring you more exciting stories in the future, so do please watch this space!

For contributions and feedback, please contact:

Vidya Rana
Senior Communications Manager, ADPC
nusrat.rana@adpc.net

In This Issue

On the Lowari Pass
Cover photo by Raki_Man

Lead Story

Interview with *Prof. Adolf Ng*

Prof. Adolf K.Y. Ng is a Professor of Global Value Chains at Beijing Normal University-Hong Kong Baptist University United International College in China and Université Laval, Quebec, Canada.

Prof. Ng is also Chief Editor of The Maritime Economist, which is the official magazine of the International Association of Maritime Economists (IAME).

Prof. Adolf K.Y. Ng (left) talking with Russell Isaac, Regional Expert, Communications and Knowledge Management, ADPC (right).

What effects does climate change have on ports and the roles they play in global supply chains?

The impacts are diverse depending on the geographical areas the ports are situated in. On the one hand, rising sea levels, flooding, and higher frequencies of storms and hurricanes can damage port infrastructure and lead to shutdowns. On the other hand, decreasing water levels in rivers due to droughts means larger ships can't cross through.

This disrupts port operations and will likely increase the cost and prices of handling cargo and they won't be able to go through their next mode of transportation like road or rail.

Just in a matter of days, supermarkets will start facing shortages, and factories that depend on imported raw materials and semi-finished goods will have to halt production. This will have serious impacts on the local/regional economy.

Ports can also be indirectly affected by the impacts of climate change because of their integrated networks. For example, a storm can affect multiple ports or cargo deliveries along a supply chain network.

What specific issues are island states like Sri Lanka and the Maldives facing?

Usually, they are the most vulnerable to the impacts of climate change and their capacities are usually not very high. They are highly dependent on trade and connection to sustain their economy and society.

Since island states are surrounded by water, ports are normally the starting and ending points in their transport networks, so trade and people's mobility depend largely on the quality of air transport and marine transport. They usually don't have many alternatives, such as land or rail, if ports are disrupted.

They immediately feel the impacts of ports being shut down due to natural hazards and become trapped. Sri Lanka, as an island state, has a large landmass and resources which offer alternative transport modes such as roads, but countries like the Maldives consist of scattered archipelagos that are much smaller and not as self-sustainable.

They also don't have as much transport infrastructure as they are limited to specific ports as their only connection point with the rest of the world or their territory.

What about the domino consequences on landlocked countries like Nepal or Bhutan?

Landlocked countries and regions like Northeastern India depend more on their often bottleneck connections with neighboring countries and communities.

Their physical constraints due to climate change impacts make it difficult to find alternative modes of transport if roads are blocked or damaged. For example, resorting to air or rail transport out of necessity can be much more expensive.

Landlocked areas need substantial financial commitments to build up the necessary infrastructure and capacities to support these alternatives.

On the other hand, many of their exports are dependent on international agreements and moving goods from the landlocked region to a maritime port. Politically, these ports don't belong to them, so they have to negotiate and make agreements to find a solution.

Your previous studies in dry ports have shown that developing countries are more cluster-orientated, could you explain what this means?

I'd like to use the example of Northeastern India again, which is mostly a tea-growing area. Many tea farms and companies here are quite small, so they struggle to reach a lot of markets because of the high logistical costs associated with smaller cargo exports.

When climate change affects their transport networks, these smaller companies can conglomerate their cargos together to overcome disruptions and increase their competitiveness.

Dry ports may not necessarily be the most efficient and many have low-quality transport connections, but they often play a very important part in promoting regional development and local production to become competitive and benefit local economies.

Considering the interconnectivity between roads, sea, and air transport, what climate change impacts are we seeing in Asian countries?

Apart from climate change, the transport sector is also greatly impacted by the COVID-19 pandemic and changing relationships between different countries.

When we consider the result of climate change on Asian countries, we need to keep in mind that everything is about offshoring, and this causes specialization in different parts of the world.

I would like to share a new concept – we are actually seeing more friend-shoring than offshoring. Different economic blocs are trying to redesign their structures based on their trade relationships.

Based on this transformation, climate change is also helping to accelerate this development. Climate change is causing certain kinds of hazards and impacts and port disruptions, and it is possible to address this problem. But a lot of the infrastructure and facilities need capital-intensive investments to build up their resilience. This means that the global supply chain or offshoring might not be as attractive as it was before. By transforming global supply chains into more regional or offshoring to friend-shoring, in my opinion, climate change is going to accelerate this transformation process.

How do you view the arguments related to climate adaptation versus mitigation?

From my more than 10 years of research on this topic so far, we have always seen that much more attention has been put on mitigation. One of the most important is that we have international frameworks like the Kyoto Protocol and Paris Agreement that are trying to control greenhouse gas and CO2 emissions.

Mitigation is about trying to slow down climate change and its impacts. We try to develop international best practices and standards so we can expect different sectors, areas and countries to establish something similar.

Adaptation is quite different – we already accept that certain types of hazards have already taken place, so based on these problems, how are we going to do something about them and make ourselves more resilient?

Adaptation is fundamentally a very local, bottom-up aspect. Will there be a national or international best practice that we can follow? It is possible but if we try to assume that problems related to adaptation planning can be implemented only based on international best practices, this will be a very wrong approach.

If we are facing a particular issue related to adaptation, once we have created a best practice, we also need to be very careful not to try and make it a (rigid) key performance indicator.

We need to understand the nature of this problem and can we look through different types of local experiences and try to match these approaches to our contexts.

I think that we should be more careful that adaptation is not some kind of one-size-fits-all strategy. This happens in a lot of ports when they conduct activities like environmental planning in the first place. Very often they put mitigation and adaptation efforts into the same plan. While they are arguably similar, both mitigation and adaptation require their own plans.

Prof. Ng spoke with Russell Isaac, Regional Expert, Communications and Knowledge Management at ADPC.

A road section in Nepal left untreated due to insufficient risk-based planning (Photo by: Nurul Alam)

Perspective

Paving the Way for Resilient Roads: *the Secret Lies in Proper Planning*

By Nurul Alam

Climate-resilient transport infrastructure is considered the backbone of livable and productive cities and rural communities. Paved and rural roads in South Asia are necessary for access to essential goods and services, such as jobs, education, health, food, and markets.

According to the World Bank Group's South Asia Climate Roadmap, an additional 20 percent monsoon rainfall is predicted for the Ganges, the Brahmaputra and the Meghna (GBM) basin by 2050, suggesting more severe inland flooding that will damage roads, impair accessibility, and result in disproportionately high costs to bring them back to service.

This article explores the necessary steps for road and transport authorities to incorporate climate-resilience related data and decisions into their road planning to protect the transport sector.

A blueprint for climate resilient roads

Planning is the most critical phase of the project cycle to ensure that climate risk information is integrated into road and bridge developments. Examples include project identification and preparations for a feasibility study.

At this stage, authorities assess not only the climate-related hazards to which the infrastructure will be exposed to, but also the project's potential environmental impacts on surrounding areas.

Planning helps ensure that appropriate risk-reduction measures are included in the project's scope, layout, major components, and cost estimate.

If climate considerations are not incorporated into the planning stage, then it is unlikely that they will be adopted later.

The key entry points for climate scopes are the initial planning stages of the development cycle such as programming, identification, and appraisal.

If authorities attempt to incorporate climate risk reduction solutions after these stages and after the budget has already been set, then it will not be sufficient to meet demands.

Contrary to popular perceptions, the consideration of climate-induced hazards and risks at an early planning stage actually leads to cost savings.

For example, by conducting a careful assessment of landslide hazards in a mountainous area, project planners will be able to identify and avoid high-risk areas when working on the preferred alignment of a new road, thereby avoiding expensive slope stabilization procedures that otherwise won't be identified until geotechnical investigations are carried out during the detailed design stage.

Similarly, informed consideration of the impacts of floods on roads may lead to economical and safer solutions.

Adjusting standard operating procedures (SOPs) to allow for this may require changing the budgeting process through climate-resilient policies and strategies — initially to provide the necessary budget allocations for surveys and investigations during the planning phase and supplementary investigations required during the detailed design stage.

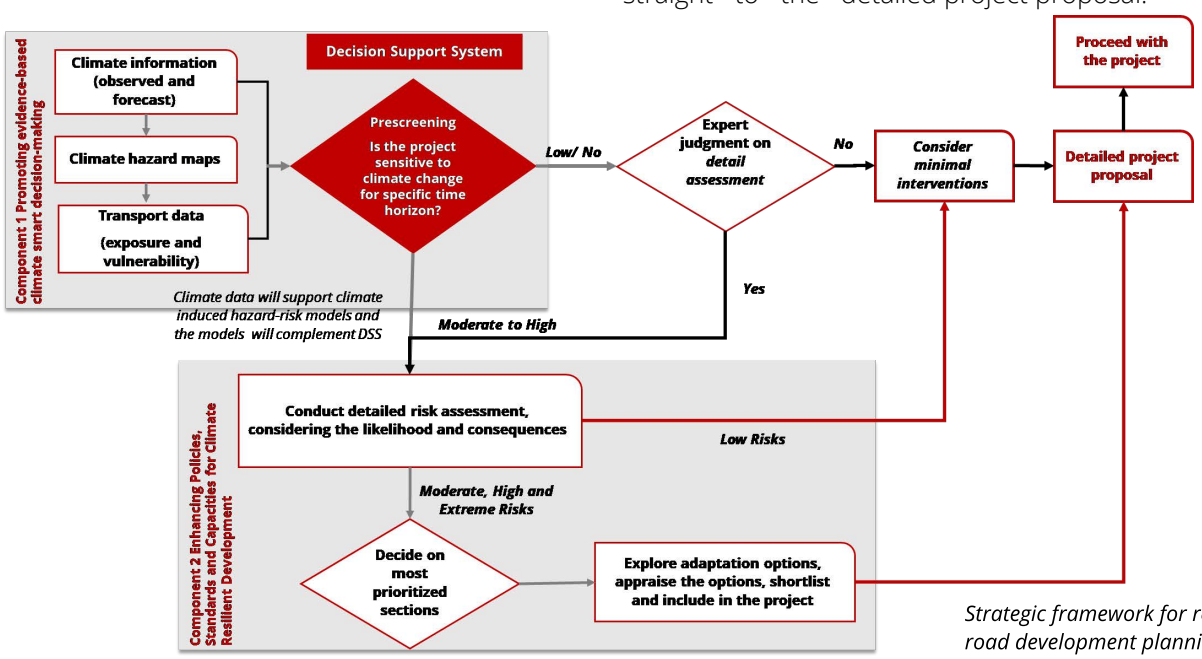
How authorities should start:

Moving onto the second component creates a series of options for further action. Conducting detailed risk assessments will model and map various climate-induced hazard risks to support appropriate road policy formulation and spatial planning.

DSS and hazard-risk information will collectively help the implementing agencies take decisions on whether they can proceed with any road development project with the typical procedure or they may need to conduct a detailed investigation (climate risk assessment) to explore adaptation options, appraise the options and include those in the project budget.

If acceptable risks are higher, then it is suggested to decide on the most prioritized sections and explore possible adaptation and resilience options before going into the project proposal.

But if hazard risks are low, then authorities can consider minimal interventions and move straight to the detailed project proposal.



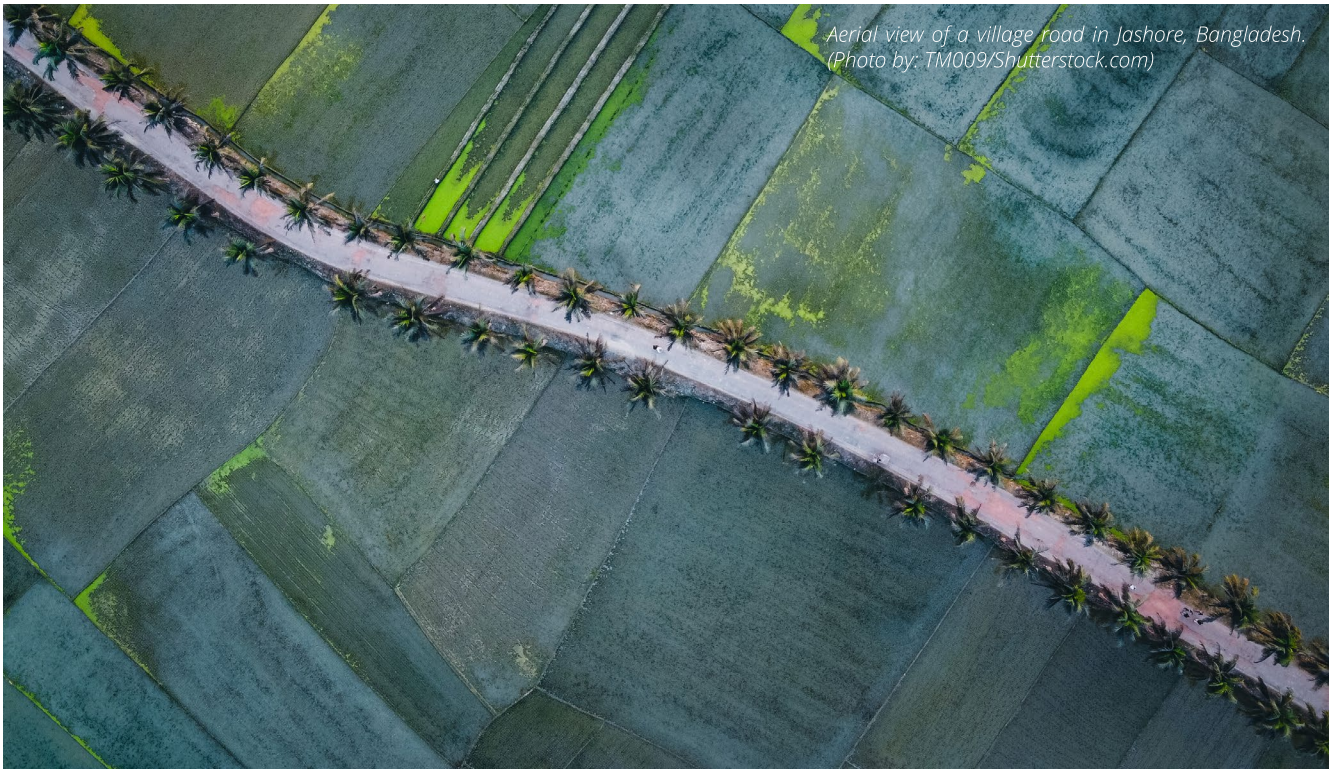
Strategic framework for resilient road development planning (Figure by ADPC)

Research is key in the first component – detailed studies of climate information, climate maps and transport exposure and vulnerability data will help formulate a strategic and resilient road plan.

Next, use a decision support system (DSS), which hosts a comprehensive database of past climate data and future projection scenarios to fortify the plan. It will help determine how sensitive the project is to climate change impacts over a specific period.

Proper strategic action plans are required to address all these issues in the stakeholder level. Finally, capacity building of the stakeholders is the major driving force to enable them to take climate risk informed decisions.

The writer is Resilient Infrastructure Specialist at ADPC and can be reached at:
✉ nurul.alam@adpc.net



Aerial view of a village road in Jashore, Bangladesh. (Photo by: TM009/Shutterstock.com)

Low-Volume Roads in South Asia: *a Marginalized Lifeline*

By Dr. Ing. Milad Zamanifar

Contrary to popular belief, low-volume roads are characterized by their reciprocal socio-economic benefits instead of their traffic levels. According to a 2016 study, they are either the starting or ending points of the global economy and culture.

Low-volume roads go beyond engineering - they are a vessel for sustainable development.

Most rural roads in South Asia are low-volume, but they are rich in relevance and operate as critical infrastructures for local communities. Therefore, their administration is a manifestation of swinging between technical and non-technical interventions. Authorities must view them as a civil-engineering responsibility that should coexist sustainably with the surrounding ecosystem to protect nature and livelihoods.

According to a 2020 World Bank estimate, nearly 80 percent of the Nepalese population and over 60 percent of Bangladeshis live in rural areas. These high rural populations mean that their health, livelihoods, and socio-economic functions depend on the functionality of low-volume roads, while their local economies rely on locally-produced commodities and a systemic lack of redundancy in road networks.

Although the design, speed, and geometric design requirements are lower in low-volume roads, a reliable and safe design remains as crucial as is for higher administrative classes of roads. Thus, while mobility, in terms of free-flow speed, can be compromised, accessibility and connectivity of low-volume roads are enormously vital for overall network performance. That is because rural and low-volume roads constitute a vast share of countries' road networks and are often the sole link of accessibility to many human settlements. Accordingly, the necessity of prevention and resilience interventions is pronounced due to their criticality for users and the post-hazard-affected population.

However, the regionally-practiced design principle takes traffic loading as the benchmark for indicating the importance of road sections and as a governing factor for allocating design resources, which does

not necessarily consider the consequence of the link's failure.

It aggravates even further when many national design standards in South Asia consider only the number of commercial vehicles per day under this underlying assumption that other means of road transport contribute insignificantly to pavement deterioration.

Although this assumption is itself arguable from the pavement engineering point of view, even if we take that as a given, it makes this design policy more exclusive and, consequently, low-volume roads rather marginalized. Hence, it is deficient in reflecting the true application of a road segment, flawed in the inclusion of the whole spectrum of present loads, and markedly incapable of representing the relevance of road segments to the perceived social system aspects that we, as engineers, aim to serve inclusively.

A community should not be punished twice because of lower economic attributions and contributions since they have not been privileged to accommodate larger business opportunities. It is perhaps not justified that we fail in building resilience into low-volume roads while expecting their users, often comprise of socially vulnerable groups, to be resilient.

To overcome this challenge, under the adverse impact of sudden-onset hazards in rural areas, it is essential to approach the concept of resilient road infrastructures from the network level and introduce criticality-based failure risk-informed classification for the structural design.

A risk-informed classification can provide a sufficient understanding of how the failure of a certain link leaves a more severe impact on the public and network as a whole. Therefore, although the geometric design remains constant, the improvement of structural design aspects can prevent the closure of critical links under the force of cumulative climatic and non-climatic stressors.

Including criticality in terms of inter-system and intra-system dependencies is integrating the consequence of a probable failure of road assets for users and non-users into the design and planning approach. It determines the level of design (parametric values or necessary investigation level for design input) with higher awareness of the complex and interconnected risk landscape, which no longer excludes low-volume roads and rural communities. Contrary to the functional classification of roads based on sole traffic volume, the failure of a risk-informed standpoint can account for aspects that traditional classification fails to grasp.

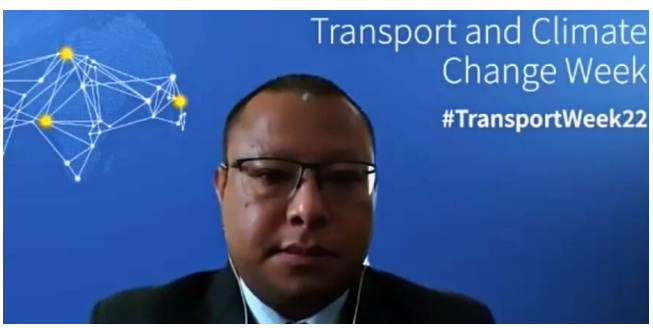
Every time we contribute to the design and construction of a reliable road, a child reaches school, a pregnant mother accesses proper medical services, a farmer sells their goods in a bigger market, a family flourishes, and a community grows.

Developing non-redundant low-volume roads that operate safely amidst climatic hazards and stressors is verifiably ethical from both utilitarian and deontological normative theories, economically viable, and technocratically justified.

The writer is Regional Transport Specialist, ADPC, and can be reached at:

✉ milad.zamanifar@adpc.net

Safety and Sustainability First: *the Roadmap to Climate Resilience*



Anish Joshi is GIS and Risk Assessment Specialist at Asian Disaster Preparedness Center (ADPC). He recently delivered an engaging presentation on promoting climate-resilient road transport infrastructure in South Asia. Watch the full presentation here.

What is the cost of climate change to South Asia's transport sector?

The impacts are quite profound. Heavy rain in Nepal caused over US $25 million in road and bridge damages in 2021, whereas flood damages to Bangladesh's roads nearly tripled from US $72 million in 2019 to US $209 million in 2020. Both countries realize that it's not only climate change causing these impacts, but also insufficient road planning and design that is making it worse.

The CARE for South Asia project is helping Bangladeshi and Nepalese road authorities recognize gaps and opportunities for climate-resilient road transport infrastructure and is developing strategic action plans. We're also recommending updates for national road and bridge design standards, mainstreaming climate change adaptations, preparing technical notes on maintenance techniques, rehabilitation, and retrofitting and recommending innovative construction materials.

At the regional level, we are developing Regional Guidelines for Climate-Resilient Roads and Bridges.

What approaches are you taking to promote climate-resilient transport?

First of all, we've developed a hazard, vulnerability, risk and criticality assessment (HVRCA) framework for road transport infrastructure based on the IPCC's 5th Assessment Report and road network asset management framework.

It helps identify the types and impacts of climate extremes and hazards experienced in the two countries, levels of exposure, what factors are driving road network vulnerabilities, potential damage and loss, and which roads are most critical for socio-economic development and network functionality.

The road development phase is critical and finance-intensive, so we also support authorities in integrating climate considerations and the HVRCA framework in all steps. We usually look at where the routes are to be planned, what climate-related hazards are these areas exposed to, and if Nature-based Solutions (NbS) can be integrated into its infrastructure among other things.

We have developed very high resolution downscaled climate change models for past climate scenarios and future projections. A standard geospatial data helps to identify exposed and vulnerable road networks in Bangladesh and Nepal, analyze observed impacts, and anticipate future impacts and risks.

For example, we noticed a decrease in annual precipitation rates in western Nepal and an increase in other parts of the country. Rainfall is one of the triggering factors of landslides, especially in hilly areas and communities, and we've been able to identify and map landslide-susceptible locations to consider for existing road maintenance and future road developments.

What types of climate-induced impacts are you seeing in the region?

There are two angles mainly; observed impacts from climate extremes and observed impacts from climate-induced hazards.

A huge landslide destroyed an important road between Kathmandu and Pohkara in Nepal.
(Photo by: Pavel Svoboda Photography/Shutterstock.com)

Climate-induced hazards like landslides are fast and high-impact, but slow climate stressors like increasing or decreasing temperatures and variations in precipitation are just as damaging to South Asia's roads.

Observed impacts we've seen from climate extremes include pavement degradation, potholes, and rutting due to extreme precipitation and surface runoff. Water is a major factor that affects road surface and sub-surface. On the other hand, climate-induced hazards like floods and landslides have sometimes caused blockages in major roads, damaged road assets and affected traffic.

Apart from major roads, local, municipal, and connecting roads have also been impacted by different kinds of hazards. In Nepal, we are using a comprehensive geospatial information system (GIS) database from our focal agencies to understand how landslides affect the entire road network. We look at a specific segment of a linking road to determine its overall level of exposure and have found that where landslide susceptibility is higher, it will have a higher impact on the overall road networks.

A road is critical based on its system and/or functional performance. If a landslide blocks a road, then authorities should determine how critical the road is, whether there are alternate routes available for mobility of population and freight, how its blockage will affect traffic and emergency performance, and possible socio-economic impacts.

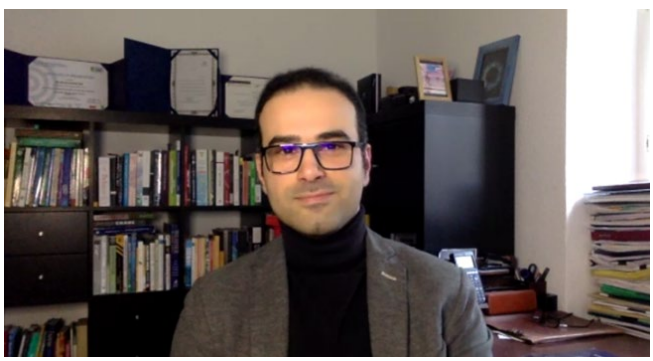
What future activities do you have planned?

Institutionalization and sustainability are very important factors in our work. We plan to integrate the HVRCA framework into national strategies for climate-resilient infrastructure that we are developing along with road agencies and also integrate the framework into all phases of road transport infrastructure development.

We will also be conducting national training events and workshops, beginning with an online virtual platform along with ADPC Academy focusing on hazards and criticality assessments, as well as promoting networking and partnerships with academia to embed this method into engineering courses especially related to the transport sector and road design.

The writer is GIS and Risk Assessment Specialist, ADPC, and can be reached at:
✉ anish.joshi@adpc.net

The Right Track for Climate-resilient Road Infrastructure



Dr. Ing. Milad Zamanifar is Regional Resilient Transport Specialist at ADPC. He recently delivered an engaging presentation on the concept of resilience and linked it to the impacts of climate hazards on transport infrastructure. Watch the full presentation here.

How does climate change affect the transport sector?

The adverse impacts of climatic hazards and stressors directly contribute to economic, rehabilitation and maintenance costs for both users and road agencies. It is a global challenge and South Asia is not immune to its exposure, impact, and risks.

According to a 2019 study, flooding accounts for over US$ 9.6 billion of direct disaster damages to the world's roads and railways every year, where South Asia's level of exposure to such hazard impacts is very critical.

Road infrastructures are particularly vulnerable to several climatic factors such as temperature and precipitation, as well as climate-induced hazards such as rainfall-triggered landslides, storm surges, sea level rises, and flooding.

How is the concept of resilience applied to transport infrastructure?

Today, infrastructure systems are highly inter-connected and their resilience relates to their core characteristics such as agility, changeability, and adaptability.

With over 50 definitions for infrastructure resilience, it means different things to different stakeholders. Without a suitable definition, road agency decision-makers may be reluctant to explore resilience-building efforts.

A 2014 study shows how the resilience concept has been linked to indicators of road performance such as mobility, travel time, and physical conditions. When a hazard strikes, it is not certain that performance will drop significantly or recover quickly depending on the robustness, strength, and physical conditions of the road.

Ideally, we want to be able to reach a point of pre-event or better performance after the hazard and this depends both on our abilities and the road's ability to recover. Nevertheless, we are often not able to immediately see the full spectrum of the system failure during sudden onset hazards (i.e., flash floods) or slow-onset hazards (i.e., rising temperatures), as roads may exhibit deterioration like stripping or rutting sometime later.

Transport resilience also can be approached based on ex-ante state, referring to the capacity to absorb shocks while maintaining the function, and ex-post behavior, projecting the ability to return to a new stable operational condition after a given shock.

Therefore, the concept of resilience infrastructure can be perceived as a degree of the processing of a set of capabilities that indicate both properties and behavior of the system. Either we are talking about the ex-ante or static properties of the system – where we are describing the current condition of the asset that we are interested in as well as the state of the system and how it can withstand the hazards.

Or we can also talk about the ex-post dynamic behavior of the system, what it does after the event, and how it is expected to respond during and after the shock.

How do we start analyzing road resilience?

Without proper scoping and limiting the boundaries of the problem, we won't have a chance to understand it fully, let alone solve it. The infrastructure resilience scope analysis consists of dimension,

Rescuers measuring the extent of damages at Bara Bridge in Peshawar, Pakistan. (Photo by: Asianet-Pakistan/Shutterstock.com)

temporality, hazard system, life cycle, spatial scale, system-level, level of effort, and an intervention phase. After identifying the scope, we move on to properties the first is redundancy or buffer capacity which focuses on how if one component fails, another component compensates. During a flash flood, for example, we can either think of providing additional culverts for the flood or think of an alternative route.

The second property is rapidity or quick recovery – we can employ traffic management systems to ensure mobility or pre-event planning for rapid restoration. The third property is resourcefulness, focusing on navigating resources and interventions in response to shock or preparedness before adverse events.

The fourth and last property is robustness which explores structural strength and reliability and how the road is still performing although the shock is there. For example, polymer-modified bitumen (PMB) can protect against extreme heat or anti-corrosion materials in maritime environments and maintenance plans.

These properties allow us to disaggregate an abstract concept like resilience to break it into smaller parts so we can analyze it better. They're also important since they assist with navigating and defining proper attributes. Selecting properties is our primary target of the scoping and is a very important step toward assessing resilience.

For example, extreme precipitation can have significant impacts on roads with regard to the road's structure and surface. Water can get trapped between the base and sub-base causing swelling and shrinking of soils, or reducing the adhesion bond between the aggregate and the binder which in turn can lead to surface cracks and stripping. Therefore, we can use the properties to arrive at the attributes which will help us in our evaluation of road resilience.

What solutions can be implemented in South Asia?

First of all, drainage systems are very important for South Asia's roads based on current climate conditions. The structural capacity of a pavement with a well-functioning drainage system recovers considerably fasters after rainfall. It could take up to three years for a road's subgrade to drain out the impact of saturation after flooding and it can lose up to 60 percent of its load-bearing capacity if it has been fully soaked.

Authorities have a 'window' to build road resilience in the planning, design, construction, and operation phases. For example, some pavements can have a design that allows the water to flow down into a sub-surface drainage system or adopt a different strategy with a lower air void design to stop water from infiltrating altogether.

Authorities should integrate exposure and hazard risk assessments into their planning phase so that they are aware of what is happening and what will happen to roads. Next, they need to enhance and change the design input based on exposure and vulnerability, specifically the input of hydrologic models based on the future impacts of climate-induced floods.

Climate information, especially precipitation and temperature and their changes, should be a leading factor in the design process. I normally observe in South Asia that authorities consider the California Bearing Ratio (CBR) and axle loading, which are of course important, but they are not the only hazards. This climate information should also be up to date to be a reliable source of information.

Road agencies are facing a variety of constraints, for example, if they want to control the groundwater table, agricultural authorities may want to increase water supply and flow in a specific area. There has to be some liaising between different authorities to integrate water resources management which also protects road infrastructures in the region.

What are common issues for road standards in South Asia?

Oversimplification and not including climate stressors as a governing design factor are some of the key priorities that need to be addressed in South Asia's road standards. There is also a lack of guiding documents for hydrological designs and drainage systems which is important since the number one enemy of the road is water – water is destructive as frost, as it crystallizes, as moisture on the surface, and as a force.

Another issue that needs highlighting, is ensuring more attention to low-volume and rural roads. In South Asia, low-volume roads are actually lifelines for the communities they serve despite their limited traffic. If authorities only count the number of commercial vehicles using specific roads and nodes, then low-volume roads could be deprived of better structural attention which emphasizes the role of criticality assessment in the asset management phase and planning.

The writer is Regional Transport Specialist, ADPC, and can be reached at:
✉ milad.zamanifar@adpc.net

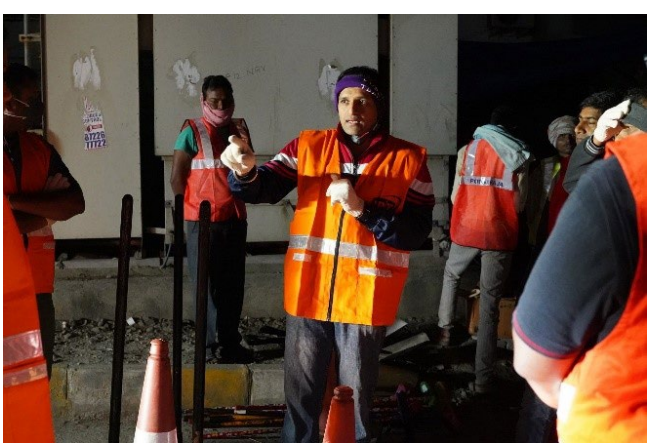
Business Leaders of Resilient Roads and Reasoning

The Transport sector is both a driver and victim of climate change impacts. According to the World Bank, transport accounts for 20 percent of the world's greenhouse gas emissions and with urbanization and motorization on the rise in developing countries, this could grow to 60 percent by 2050.

Air pollution aside, transport development also poses a series of environmental threats. According to the World Roads Association (PIARC), road construction contaminates soil with hazardous substances, causes loss of habitat and impacts the landscape – thereby exposing the surrounding areas to increased risks of flooding, erosion and landslides.

This article explores how business leaders across the world are reshaping perceptions on respecting nature and resilient transport initiatives.

Patched-up and Pothole-free



Dr. Prathap Rao, a.k.a PotHole Raja, helping fix potholes in Bengaluru, India (photo by: PotHole Raja, 2022)

Potholes are a proper pain for road-users, damaging cars and putting lives at risk. They are predominantly caused by water and traffic. Water weakens the soil beneath the pavement while traffic applies the loads that stress the pavement past the breaking point. Left unrepaired, they will grow wider and deeper and more dangerous.

Dr. Prathap Bhimasena Rao, Founder and CEO of GroundReality and PotHoleRaja, is on a mission to develop sustainable road infrastructure in the bustling burg of Bengaluru, India. ADPC spoke to him on the sidelines of the Seventh Global Platform for Disaster Risk Reduction to learn more.

'While constructing roads, the possible disasters, climate, environmental hazards, and structure longevity are not evaluated,' he explains. 'Therefore, when disaster strikes and the connectivity is lost, reaching the place looms as a foremost hurdle to cross.'

Setting down the GridMats technology over damaged roads (Photo by: PotHole Raja, 2021).

The PotHole Raja patches potholes with recycled plastic. His GridMats technology has helped blanket over 20,000 potholes and develop over 500 km of SMART roads across India!

'The GridMats can be installed with various sensors to recognize the potential threat of landslide and breakage,' he says, adding that it is particularly useful in hill ranges that experience extreme weather.

'PotHoleRaja has used GridMats in Himachal Pradesh, Himalayan range roads with fragile movements, and internal roads for the commercial and residential complex,' he says. 'They hold the soil without erosion. This makes it very useful in rain and flood-prone areas, and it can handle the widespread compressive or vibratory movement during disasters like landslides or floods.'

The GridMats are strong and durable as well, with a load bearing capacity of over 407 tons per square meter for empty grids and have a lifespan of 50 to 100 years. They also save up to 65 percent of concrete and require less water usage for curing, thereby reducing the need to use more fossil fuels

during construction and maintenance. But the PotHoleRaja is going digital as well. Working with multiple partners and communities, it is developing a series of SMART roads using sensors and the Internet of Things and harnessing solar energy on roads with micro grids for local and large-scale supplies.

'Governments need to focus on creating sustainable solutions that will withstand the potential and predictable disasters rather than developing strategies to handle disasters after they have occurred,' he explains. 'If the infrastructure constructed is resilient, it can withstand times of disaster as well as aid reconstruction.'

Fishing for Responsible Recreation:

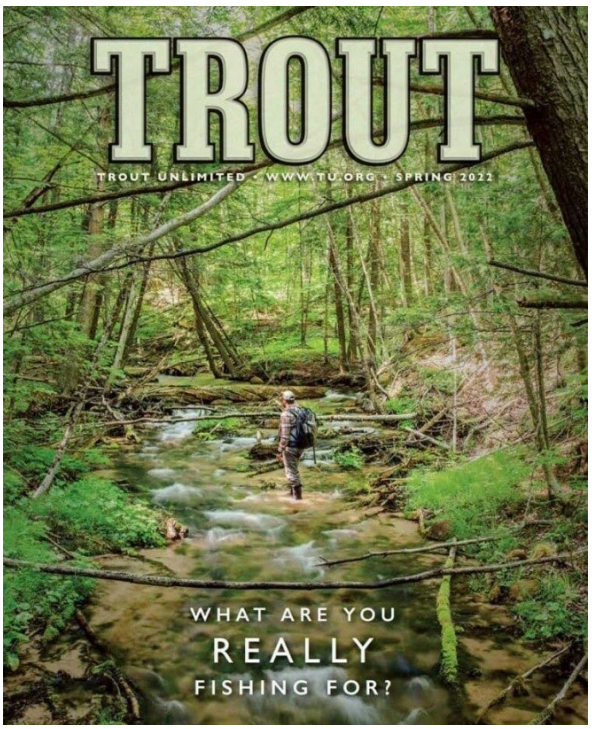
An offroad vehicle plows through a stream (photo by: ahmad syahrir/ Pexels).

It's an all-too-common sight that features on many screens and billboards – 4x4 trucks plow through rocky ridges, steep hillsides and running rivers to demonstrate humanity's dominance over the great outdoors.

One non-profit organization has had enough of it! ADPC reached out to Trout Unlimited Media (TU), who are dedicated to conserving, protecting and restoring North America's cold-water fisheries and their watersheds and to hear how they are encouraging auto companies to put the brakes on fantasizing environmental destruction.

'We're offering to support the first company that steps up and leads by positive example, showing their product facilitating the enhancement or enjoyment of a river, rather than destroying one,' says Kirk Deeter, Editor-in-Chief of Trout Magazine.

The quarterly magazine, which boasts over 330,000 members and supporters, is offering a free full-page ad space to auto companies to the tune of over US $6,000.



The campaign run by Trout Unlimited Media accompanied by the caption 'People who know what they're really fishing for wouldn't think to drive a truck through this.' (Photo by TU, 2022)

The catch? TU wants to see offroad vehicles engaged in responsible environmental acts such as hauling trees to be planted along the river bank or carrying a crew that's restoring a stream.

'Driving through rivers severely damages the ecosystem—plants and animals alike, so it's particularly offensive to have that linked to the outdoor/fishing lifestyle,' he says. 'But we've come to the conclusion that those companies simply don't know any better'.

The campaign is receiving positive publicity online. Company Directors and Brand Strategists are actively sharing the campaign on social media to change current perspectives on outdoor recreational activities and promote meaningful environmental action.

In 2021, TU also successfully convinced an auto company to pull a similar ad from further broadcasting. The auto company also sent a letter of apology and made a contribution to support TU's work.

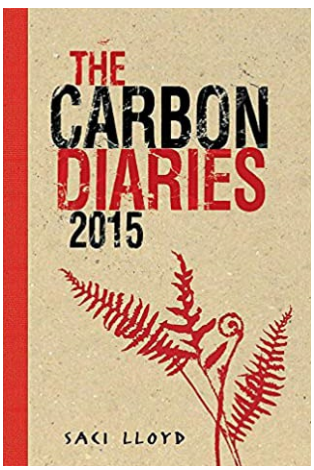
This article is compiled by Zandre Van Straten, Knowledge Management Officer, Risk Governance department, ADPC. He can be reached at:
✉ Zandre.vanstraten@adpc.net

Cli-Fi

Climate Fiction and Climate Realities

Climate Fiction, popularly abbreviated as 'cli-fi', is a great source of learning about climate change and its potential impacts on humanity

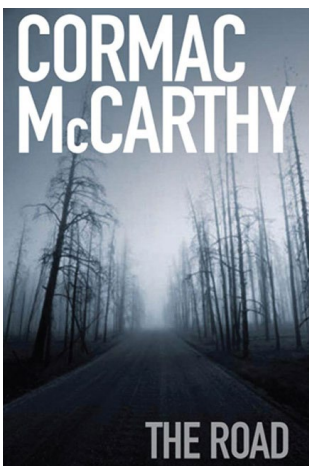
Books:



The Carbon Diaries 2015
by Saci Lloyd (2008)

This fictional diary recounts the feelings and frustrations of a teenage girl growing up in the first country to impose a carbon tax system. Soon enough, imported food becomes too expensive, her parents lose their cars and jobs and her ability to live a normal life is forever impeded. It draws attention to the inevitable day that transport-based pollution catches up and we must all pay the price.

How can we reduce our transport carbon footprint in our daily activities while balancing economic growth?



The Road
by Cormac McCarthy (2006)

At times of disaster, equilibrium is achieved by staying in motion. In this classic novel's post-apocalyptic, ash-covered United States, following an extinction event, a father and his young son make their way to safety using the only medium that remains: the road. Taking interstate highways to journey south, the duo's ordeal is a modern parable for these times of climate crisis.

How can we plan for a future wherein the transport systems and infrastructure we are accustomed to are under threat?

Movies:

Mad Max: Fury Road
by George Miller (2015)

This classic diesel-driven franchise returns with our hero caught in a world turned into desert wastelands and society's collapse from overusing resources. Through its action-packed car chase scenes, It reflects cultural fears of climate change and implicates our reliance on fossil fuels, engines and industrial progress as the cause.

What laws, policies and mechanisms can help fast-track societies transitioning to renewable energy and transport?

Snowpiercer
by Bong Joon-Ho (2013)

It is 2031. After an attempt to halt global warming has failed, creating a new ice age, the remaining humans have taken to a self-sustaining train that traverses the world. Tensions in the new hierarchy are felt in the divisions between the elite and the lower-class sections of the train. The rebellion that ensues, as the train hurtles around the globe, is the focus of this riveting, acclaimed film.

Unchecked, non-inclusive development will send us all on a never-ending train ride through the ecopocalypse.

Breaking the Jargon

By Dr. Ing. Milad Zamanifar

Road Design Phase

Design discharge: the maximum flow of water a bridge is expected to accommodate without exceeding the adopted design constraints.

Design Highwater Elevation: the usual term used to describe the estimated water surface elevation or profile in the stream (or other surface waters) at the project site for the selected design discharge.

Design Flood Frequency: the frequency (recurrence interval) for the selected design discharges (storms) that is expected to be accommodated without contravention of the adopted design criteria.

Design Speed: a selected speed used to determine the various geometric design features of the roadway.

Construction Phase

Dense-Graded Aggregate: a continuously graded aggregate from a specified maximum size to dust, so as to have a low aggregate voidage.

Open-Graded Aggregate: a well-graded aggregate containing little or no fines, with a relatively large percentage of voids.

Skip (Gap)-Graded Aggregate: aggregate possessing a disproportionate distribution of successive particle sizes.

Well-graded Aggregate: an aggregate possessing a proportionate distribution of successive particle sizes.

Pavement Management System (PMS): a set of tools or methods that assist decision-makers in finding optimum strategies for providing, evaluating, and maintaining pavement in a serviceable condition over a period of time.

Maintenance Decision Support Systems (MDSS): automated guidance systems to integrate data on current road conditions and approaching weather to predict future road conditions and generate directions to maintenance personnel on various roadway treatment options.

Road Weather Information System (RWIS): sensors installed in the travel lanes of the highway that measure the temperature of the pavement. Atmospheric sensors are placed adjacent to the pavement and measure air temperature; relative humidity; wind speed and direction; precipitation type, intensity, and rate; and the driver's perception of visibility to assist public agencies in maintenance decision making.

Transportation System Management (TSM): actions that improve the operation and coordination of transportation services and facilities to affect the most efficient use of the existing transportation system.

For more useful terms and definitions, please consult the American Association of State Highway and Transportation Officials (AASHTO) Transportation Glossary.

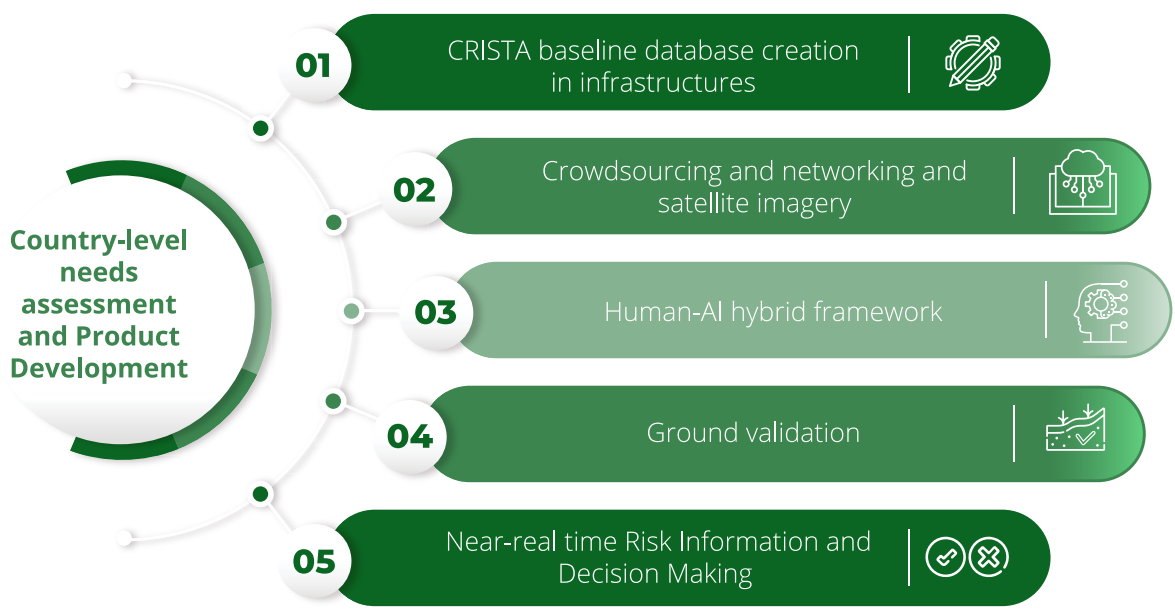
Featured Innovations

The Asian Institute of Technology (AIT) will deploy near-real-time monitoring of road and power infrastructure using advanced geospatial datasets with the help of crowdsourcing and artificial intelligence via android application and associated (Climate Resilient Infrastructure for Social Transformation and Adaptation or CRISTA) Dashboard in Bangladesh and Nepal. The pilot is intended to support the decision-makers in addressing risk information gaps to improve community-level climate resilience through risk sensitization.

Introduction

- Digital database generation for road and power infrastructure
- A human-AI hybrid framework will be developed to tune up and improve the performance of the system
- Dynamic risk and assessment of the critical infrastructure through learning-based disaster damage assessment (DDA)

Development and Implementation



Expected Impacts

- Address climate hazards
- Social transformation
- Risk reduction and decision-making
- Real-time monitoring of critical infrastructure

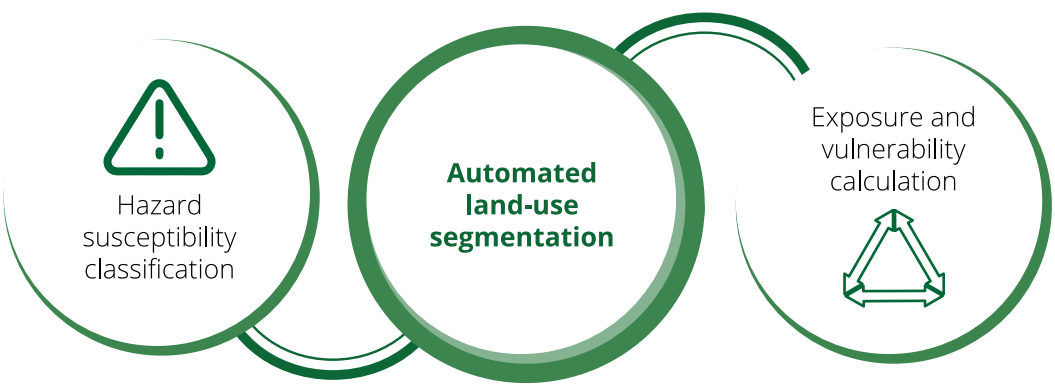
Geoneon, in partnership with Terranum, the Department of Disaster Management, and the Department of Roads in Bhutan, is implementing a solution to assess the vulnerability of infrastructures to slope instabilities and floods in Bhutan to support the development of strategies for disaster risk reduction and climate change adaptation. The solution is called 'Infrastructure Vulnerability to Slope Instabilities and Floods in Phuentsholing, Pasakha, and Gelephug (Bhutan)'.

Introduction

Identify hot spots where critical infrastructure is most vulnerable to climatic disaster

support decision-makers to develop appropriate mitigation and monitoring measures to reduce the number of affected people, direct economic loss, damage to critical infrastructure, and disruption of critical services to the community.

Process



Expected Impacts

Data-driven approach to anticipate possible impacts before disasters happen

Efficiently assess the extent of hazard susceptibility and related vulnerabilities at a large scale

Current and up-to-date data owing to near-real-time earth observation data and scalable due to reliance on advanced algorithms and machine learning.

These unique technologies are part of the 16 winners of the Climate Innovation Challenge (CIC), which aims to crowdsource innovative and disruptive technology solutions from around the world for resilience in South Asia.

The Program for Asia Resilience to Climate Change, a trust fund administered by the World Bank and funded by the United Kingdom's Foreign, Commonwealth & Development Office (FCDO), has made US$ 3.5 million available to ADPC through the TechEmerge Resilience India and CIC to identify and pilot innovations to reduce climate risk and build climate resilience of communities vulnerable to such risks and extremes. Learn more by clicking here.

CARE for South Asia Project Updates

ADPC organized a regional Innovations in Climate Adaptation and Resilience (iCARE) workshop to bring together 19 innovators from across the world to reflect on the new technologies and innovations to mainstream climate information and advice to vulnerable groups.

The TechEmerge and Climate Innovation Challenge (CIC) financed by the Foreign, Commonwealth and Development Office (FCDO) of the Government of the UK through the World Bank's Program for Asia Resilience to Climate Change (PARCC) Trust Fund, is supporting innovation challenges across South Asian countries that is crowdsourcing innovative and disruptive technology solutions for resilience. They aim to facilitate innovative solutions for their application and scale-up across different sectors, and tiers (national, sub-national and local/community) for greater impact. Further details are available at www.adpc.net/cic & www.adpc.net/techemerge

The Agriculture Sector Risk Assessment (ASRA) data collection using an online survey with stakeholders has been completed in Bangladesh, Nepal and Pakistan. Experiences and perceptions of farmers and field level extension workers on observed climate change impact on agriculture were also collected and analyzed. The information will contribute to a better understanding of the major observed risks and impacts of climate change on agriculture and livestock in all three countries.

Field visits were conducted in multiple districts in Bangladesh and Nepal to observe flood and landslide impacts on roads and bridges and understand the vulnerability and criticality of rural road infrastructures. A field visit was also conducted in Bangladesh to gather information about climate risks and impacts on agriculture and local practices to respond to such challenges.

ADPC organized a series of national water sector workshops in Bangladesh, Nepal and Pakistan to discuss ongoing project activities, methodologies and progress with key water stakeholders and partners.

A knowledge-sharing workshop on 'Gap Assessment on Road Design Standard 2021 of Local Government Engineering Department (LGED)' was organized in Bangladesh to present report findings, share theoretical concepts of resilience for roads and infrastructure and findings from site visit pictures with 30 participants from LGED, technical working group members and representatives of 10 different units of LGED. Participants discussed potential design interventions for climate-resilient roads and confirmed all issues and gaps to revise LGED's Road Design Standards for the country.

ADPC organized a stakeholder workshop with Nepal's Ministry of Finance (MoF) to talk about accessing climate finance in the country. Participants explored sources, barriers, and opportunities for climate finance as well as Climate and Disaster Risk Financing and Insurance (CDRFI).

A training event was organized in Karachi, Pakistan 'Orientation of Green Climate Fund (GCF)' for 35 senior and mid-senior officials of Planning & Development Board (P&D)-Sindh. A full day training program was designed to address capacity and knowledge gaps within the relevant P&D departments and provided relevant tools and information to access Green Climate Fund (GCF). The main objective of the training was to build the capacity of P&D officials for getting accredited to the GCF.

RIMES presented its implementation plan for the "Development of Nepal's National Disaster Risk Reduction and Management Authority (NDRRMA)'s Decision Support System (DSS) for Impact-Based Multi-Hazard Early Warning System". The DSS for NDRRMA is an automated tool designed to facilitate a climate-informed decision-making process by keeping track of, organizing, and analyzing vast amounts of data to produce scenario-based choices and outcomes for climate adaptation and resilience. The NDRRMA officially approved it and development is underway.

Similarly, Pakistan's Ministry of Planning, Development, and Special Initiatives (MoPDSI) is currently in talks with RIMES for its own DSS aimed at refining the former's project planning techniques and capabilities by generating guiding insights on climate-informed development and growth interventions. Four more DSSs in the areas of finance, water resource management, and agriculture are being considered for development or enhancement.

ADPC and RIMES also organized a Technical Working Group (TWG) meeting in Nepal with the Department of Roads (DoR) to present activity progress and immediate support required from DoR. As a result, the department confirmed access to geographic information system (GIS) and road asset inventory data needed for Hazard Vulnerability and Criticality Assessment.

ADPC held an online workshop on 'Climate change hazard, vulnerability, risk and criticality assessment for road transport infrastructure in South Asia' as part of the Transport and Climate Change Week 2022 organized by Deutsche Gesellschaft für Internationale Zusammenarbeit (GiZ). The workshop presented the Climate Change Hazard, Vulnerability, Risk and Criticality Assessment for Road Transport Infrastructure in South Asia to support resilient road transport infrastructure.

Similarly, ADPC organized an online session at the Stockholm International Water Institute (SIWI) World Water Week 2022 focusing on 'Upscaling nature-based Solutions for water security and climate change adaptation' in association with the International Union for Conservation of Nature (IUCN) and Asian Institute of Technology (AIT). ADPC also co-hosted an online session "The heart of resilience: cultivating the untapped potential of women" at the same event in association with Simavi, Stockholm Environment Initiative (SEI), Water Aid and Centro de Estudio para la Democracia (CESPAD).

The Climate Adaptation and Resilience (CARE) for South Asia project brings together data, tools, guidelines, and capacity to mainstream climate adaptive measures in the agriculture, water resources management, transport, and finance & planning sectors. It contributes to an enabling environment for climate resilience policies and investments in climate-sensitive sectors in South Asia, initially focusing on interventions in Bangladesh, Nepal and Pakistan.

Implemented By

Supported By

Asian Disaster Preparedness Center
SM Tower, 24th Floor 979/66-70 Pahonyothin Road
Phayathai, Bangkok 10400 Thailand
Tel: +66 2 298 0681-92
Fax: +66 2 298 0012
E-mail: adpc@adpc.net
www.adpc.net

Regional Intergrated Multi-Hazard Early Warning System (RIMES)
2nd Fl. Outreach Bldg., AIT Campus, P.O. Box 4
Klong Luang, Pathumthani 12120, Thailand
Tel: +662 516 5900 to 01
Fax: +662 516 5902
E-mail: rimes@rimes.int
www.rimes.int