

Green Roads

Developing a Green Roads Toolkit for Asia-Pacific Transport Sector

Overview

- **Why Green Roads**
- **A Green Roads Vision**
- **What are Green Roads**
- **Supporting the transition to Green Roads**
 - Toolkit
 - Assessment tool/ guidance note
- **Cooperation**

- **Investment in the road sector is enormous and will remain SO...**
- **Closing the connectivity gap: Many communities in Asia and the Pacific (400 million) lack all-weather access to health, education, government services and economic opportunities.**
- **From 21 million to 29 million km of roads in a decade: Between 2020 and 2030 8 million km new roads will be built in Asia and the Pacific (Asia Transport Outlook 2030)**
- **There will be considerable effort in the upgrading of roads and regular asset management**
- **Huge finance: To meet increasing demand ADB estimates the costs of transport infrastructure requirements in Asia and the Pacific region to be more than \$520 billion a year.**
- **The global estimate is that \$ 1-2 trillion is invested in roads every year. Growth is most fast in Asia and the Pacific region.**

Green roads will have a transformative impact on many agendas – not just on connectivity

- The road sector is a major factor in carbon emissions (18% of global CO2 emissions)
- Roads change landscape hydrology (reduction in springs, exacerbating floods, 12-36% of sedimentation, yet this can be turned into a positive)
- Roads change local climates (wind, temperature, moisture, rainfall/dust)
- Roads affect biodiversity (second cause of wildlife kills, disconnected habitats)
- Roads have an important effect on public health (dust, heat, public hygiene)
- Due to road noise for instance 10 M healthy life years lost in Asia annually
- Roads are responsible for the extraction of 30-40% of all construction materials.
- We can also turn roads into nature-positive for example in water management, local climate and biodiversity, public health and mitigate the negative impacts!

What are Green Roads

What are Green Roads?

Comparing Regular Roads and Green Roads

- ✓ Creating connectivity and access
- ✓ Safeguarding safety
- ✓ Making affordable transport possible
- ✓ Working towards decarbonization
- ✓ Ensuring climate resilience
- ✓ Creating beneficial water and land management
- ✓ Reducing pollution
- ✓ Improving quality of life
- ✓ Preserving biodiversity
- ✓ Supporting disaster preparedness
- ✓ Sourcing materials sustainably
- ✓ Fostering inclusive growth



Synergies between the themes!

Green Roads Vision for Asia

Green roads will foster beneficial land and water use, reduce pollution, support restorative and regenerative ecosystems and enhance safe and affordable mobility of people to deliver inclusive low-carbon, resilient development and environmentally considerate outcomes in Asia and the Pacific.

The Green Roads Toolkit - informing and supporting the change to green roads

- **General:** Assessing whether the road program is green (different levels) and recommending improvement opportunities  **Assessment tool**
- **Project Level:** What do the green road investments look like, what practices to use?  **Practices using filters**
- **National Level:** What supporting regulation, policy, strategies, standards and certification, sustainable procurement, etc. to include in investments to make the transition to green roads?  **Enabling factors**

Set up of toolkit and guidance note

- 9 Green Road Themes
- 48 Intervention Areas
- 140 Good Practices

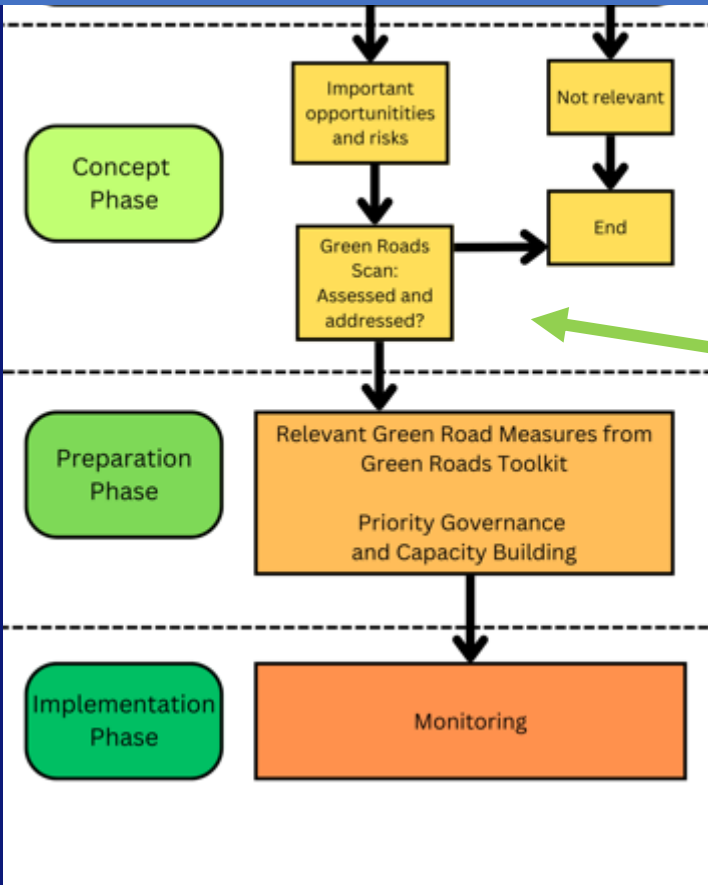
For each practice:

- Description
- Green and Regular Road objectives served
- Applicability (filters)
- Details and examples (Project Level)
- Enabling factors (National Level)
- Costs and benefits
- Photos
- Remarks/ further reading/ link to other ADB instruments and publications

Filters under area of applicability (Project Level)					
Geography and Climate	Mountainous	Flat	Arid	Tropical	Pacific Islands
		x	x		
Standard of road	Low-Volume/rural	Paved highways		Expressed highways	Urban roads
		x			
Road project stage	Planning	Design	Construction/Implementation		Maintenance
		x	x		
Degree of impact	Incremental	Progressive		Transformative	
		x			

Enabling factors (National Level)			
Improved Design Standards		Public Awareness and Education:	
Modified Tendering Procedures	x	Collaborative Partnerships	
Policy Development		Roadmaps for Green Roads	
Environmental Standards	x	Supply systems: available Resources and Materials	x
Regulatory Frameworks		Application of New Technologies	
Improved Planning Systems		Connection with other programs	

Green Roads Assessment Tool



	Green Roads Component	Scan: Assessed?	Plan: Addressed?	Non-negotiables	Positives
1	Has CO2 load calculated and mitigated?				
2	Are climate effects accurately assessed and addressed?				
3	Is hydrology and geology assessed and included?				
4	Are effects on noise, dust, heat assessed and addressed?				
5	Are pollution effects factored in?				
6	Is effect on ecology assessed and addressed?				
7	Are functions in emergency preparedness included?				
8	Is there a materials sourcing plan?				
9	Are effects on inclusive growth assessed and addressed?				

Assessment Tool

A sneak preview into the Toolkit





1. Decarbonization



- ✓ Road sector responsible for **18 % of global CO2 emissions** (IEA, 2021).
- ✓ Emissions in each phase of road cycle (material production and transport, construction, use, maintenance and end-of-life)

Key interventions areas:

- **Future roads for low carbon mobility (dig-once policies)**
- **Road network design**
- **Low-carbon Material extraction/production and transportation**
- **Design of roads and road appliances**
- **Low carbon road construction techniques**
- **Road transport management**
- **Vegetative measures along roads (e.g., roadside tree planting)**



Roadside tree planting



Smoother asphalt



Energy generation with roads



Energy-efficient LED



Using lignin as alternative bio-based binder



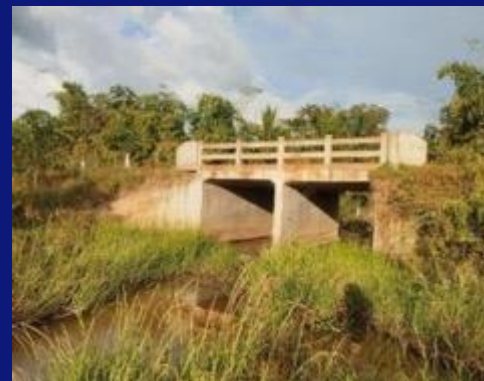
2. Climate Resilience



- ✓ Climate-related damage to road infrastructure costs countries between **1-3% of their GDP annually** (World Bank)
- ✓ Making infrastructure more climate-resilient can add about 3 percent to the upfront costs but has **benefit-cost ratios of about 4:1** (Global Commission on Adaptation)
- ✓ Need a system perspective on the resilience we seek

Key interventions areas:

- **Enabling Type 2 projects**
- **Improved asset management systems**
- **Climate resilient road drainage**
- **Increased stabilization of roadsides**
- **Adjustment in design criteria and designs**
- **Resilient routing/avoiding vulnerable areas**
- **Landscape management**
- **Special solutions for special cases (permafrost)**



Using appropriate size culverts



Deep rooted vegetation for slope stabilization



Stabilization of slopes



Streambank protection



3. Water and Land Management



- ✓ Water is responsible for **80% of road damage to unpaved roads and 30% of damage to paved roads**
- ✓ It is estimated that **20% of the global land surface is within one kilometer of road**, which is where most of the people live and where economic activities are concentrated.
- ✓ Roads have major impact on local hydrology – often with negative consequences – this can be turned around into beneficial water management, using the road infrastructure

Key interventions areas:

- Water harvesting and run-off storage
- Agricultural water management/ water level control
- Groundwater recharge with roads
- Reducing waterlogging and water congestion
- Preventing landslides
- Erosion and gully control with and around roads
- Reducing sedimentation from road surfaces



Field trench from road



Road made from excavation of drainage canal



Gully rehabilitation



Overflow road



4. Reducing Pollution



Usually, a land strip of up to **60-100 meters from the road is significantly affected** by the pollution from the road, either from run-off or the deposited road dust

Key intervention areas:

- Reconsider road construction materials
- Source control: minimize pollutants from vehicles
- Road maintenance
- Prioritize road drainage
- Proper use of de-icing/traction agents
- Capture and remove pollutants



Retention pond



Sand filter



Proper use of de-icing agents



Accumulator plants



Porous pavement (right)



5. Quality of Life



- ✓ Large **negative impacts from roads to people's quality of life**, via dust, noise, temperature and aesthetics. This can be reduced and turned around.
- ✓ Tree planting is found to be associated with significant reductions in non-accidental and cardiovascular mortality (Donovan et al., 2022)
- ✓ Use of temperature control technologies such as use of Thermosyphon can help to minimize permafrost thawing and heat island impact of road pavements
- ✓ **Closely aligned to all other Green Roads themes.**

Key interventions areas:

- **Dust control**
- **Beautification**
- **Noise control**
- **Temperature control**



Application of dust palliatives



Pavers on streets through an urban area



Noise barriers



Beautification of roads



6. Preserving Biodiversity



- To **address the biodiversity crisis**, it is critical to ensure roads do not longer harm biodiversity, but instead preserve it and that habitats stay connected

Key interventions areas:

- **Protect and harness invertebrate biodiversity**
- **Protect and harness vertebrate biodiversity**
- **Protect aquatic systems**
- **Improve roadside flora**
- **Interconnect habitats**



Overpass



Underpass




Modified culverts



Canopy bridge

Zoom in – example of practices documentation

6.2.6	Broken road-side vegetation to foster species diversity																																													
Description	Root wads and tree branches are strategically placed along the length of an overpass to create a habitat that offers shelter and protection for various wildlife species, especially those that prefer closed cover environments. This innovative approach aims to enhance ecological sustainability and promote biodiversity within the overpass area.																																													
Area of applicability	<table border="1"> <tr> <th>Geography and Climate</th> <th>Mountainous</th> <th>Flat</th> <th>Arid</th> <th>Tropical</th> <th>Pacific Islands</th> </tr> <tr> <td></td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> <td>x</td> </tr> <tr> <th rowspan="2">Standard of road</th> <td>Low-Volume/rural</td> <td colspan="2">Paved highways</td> <td>Expressed highways</td> <td>Urban roads</td> </tr> <tr> <td></td> <td colspan="2">x</td> <td></td> <td>x</td> </tr> <tr> <th rowspan="2">Road project stage</th> <td>Planning</td> <td>Design</td> <td colspan="2">Construction/Implementation</td> <td>Maintenance</td> </tr> <tr> <td></td> <td></td> <td colspan="2">x</td> <td></td> </tr> <tr> <th rowspan="2">Degree of impact</th> <td>Incremental</td> <td colspan="2">Progressive</td> <td colspan="2">Transformative</td> </tr> <tr> <td></td> <td colspan="2">x</td> <td colspan="2"></td> </tr> </table>	Geography and Climate	Mountainous	Flat	Arid	Tropical	Pacific Islands		x	x	x	x	x	Standard of road	Low-Volume/rural	Paved highways		Expressed highways	Urban roads		x			x	Road project stage	Planning	Design	Construction/Implementation		Maintenance			x			Degree of impact	Incremental	Progressive		Transformative			x			
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Details of the good practice incl examples	<p>The practice involves strategically placing root wads and tree branches along the length of an overpass or road to create habitat features that offer shelter and protection for wildlife. These root wads and tree branches are carefully positioned to mimic natural cover and nesting sites for various wildlife species, particularly herps (reptiles and amphibians), small mammals, and birds. The specific design and arrangement of the habitat elements may vary depending on the target species and local environmental conditions.</p> <ul style="list-style-type: none"> Root Wads: Large woody debris, such as tree stumps or logs with intact root systems, are anchored alongside the road or overpass. These root wads provide shelter for terrestrial wildlife, including reptiles, amphibians, and small mammals. They also serve as potential basking sites for reptiles. Tree Branches: Tree branches or limbs are strategically placed to create elevated perches for birds, especially raptors, and nesting opportunities for arboreal species. These branches may be secured to existing structures or positioned within the habitat to enhance vertical diversity. 																																													

	 <p>Langaton T., Clevenger A., 2021</p>
Enabling factors	Application of New technologies, Available Resources or Materials, Roadmaps for Green Roads, Monitoring and Evaluation
Costs/benefits	<p>Benefits:</p> <ul style="list-style-type: none"> Wildlife Habitat Enhancement: Root wads and tree branches provide shelter and protection for various wildlife species, including birds, mammals, amphibians, and reptiles. They can create safe corridors for animals to move across roads without direct exposure to traffic. Biodiversity Conservation: By offering habitat near roads, this practice contributes to biodiversity conservation. It can help preserve local wildlife populations and maintain healthy ecosystems. Improved Wildlife Connectivity: Habitat enhancements along roads can improve wildlife connectivity by allowing animals to access different parts of their habitat and migrate between areas. Reduction in Wildlife Mortality: Providing wildlife with safer routes and habitats can reduce the number of animals killed on roads due to collisions with vehicles. Costs: <ul style="list-style-type: none"> Initial Construction Costs: Installing root wads and tree branches along roads can require financial investments for materials, labor, and equipment. These costs may vary depending on the length of the road section and the complexity of the habitat enhancements. Maintenance Costs: Ongoing maintenance may be necessary to ensure that the habitat enhancements remain effective and safe. This includes periodic inspections, repairs, and potential replacements of damaged structures.
Remarks/further reading or viewing	Measures to Reduce Road Impacts on Amphibians and Reptiles in California: Best Management Practices and Technical Guidance, Thomas E.S. Langdon and Anthony P. Clevenger, 2021



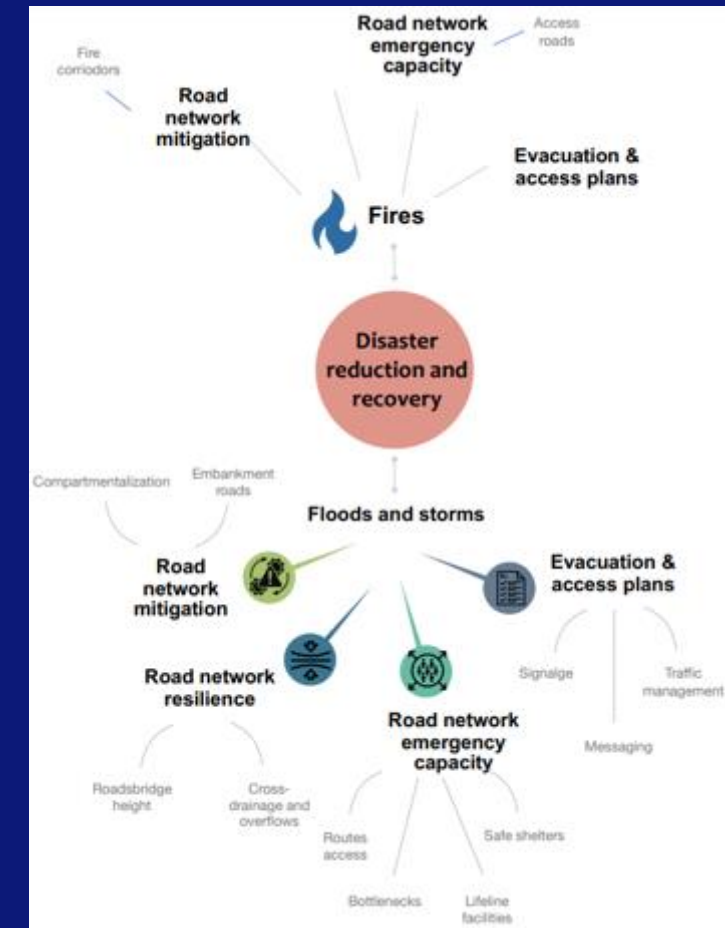
7. Disaster Preparedness



- ✓ Disasters triggered by natural hazards and escalating climate change impacts pose a worldwide **huge threat to economic and social development** in Asia and the Pacific.
- ✓ Roads play an important role in **disaster risk reduction** as well as in **disaster response** (such as flood and fire management).

Key interventions areas:

- Flood mitigation by road network (compartmentalization)
- Flood resilience of the road network
- Road network capacity to deal with emergencies
- Evacuation and access plans
- Fire prevention





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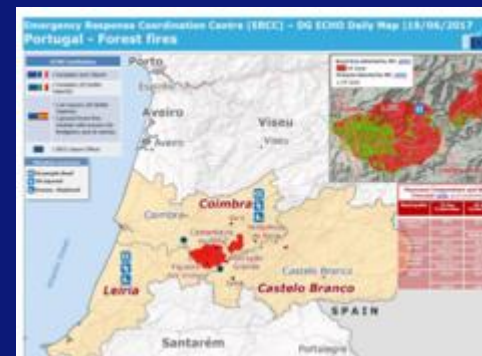
- Criticality mapping and multi-hazard risk assessments
- Early warning systems
- Flood mitigation by road network
- Flood resilience by road network
- Road network capacity to deal with emergencies
- Evacuation and access plans
- Fire prevention



Roads used as shelter



Upland water retention



Map of fire breaks



Road crossing stabilizing river course



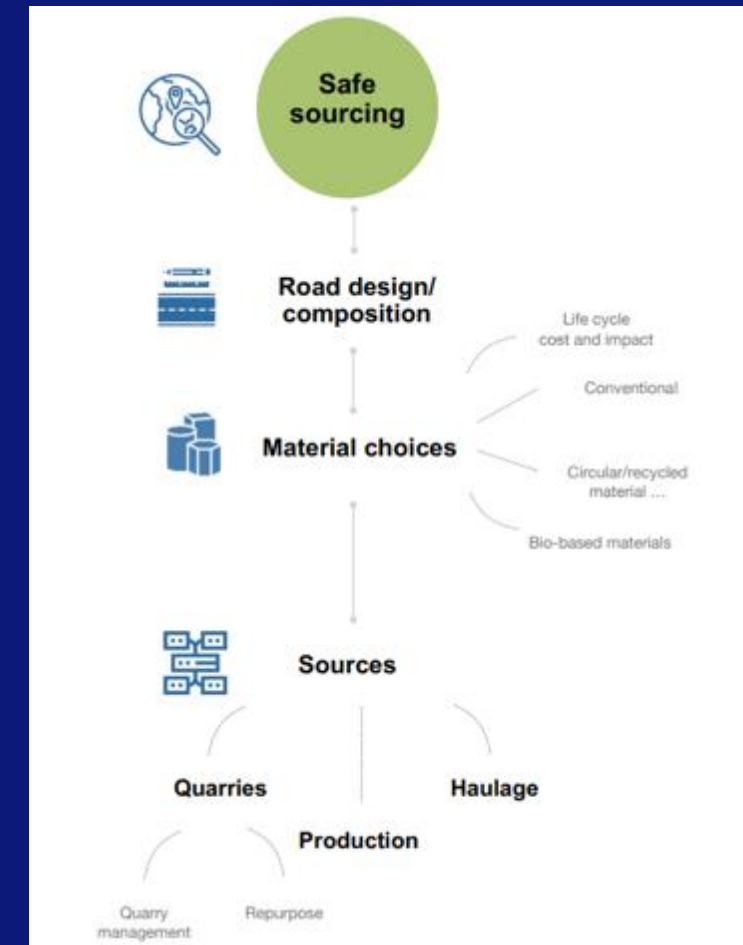
8. Sustainable Materials Sourcing and Construction Practices



- ✓ **30-40% of construction material globally is used in linear infrastructure.**
- ✓ **Asia and the Pacific is an increasing large consumer of road construction material, for instance consuming 46 million tons of asphalt a year, an increase of 64% in 10 years. – far ahead of global growth (17%)**
- ✓ **Some of the raw material is becoming in short supply (tarmac, sand, gravel) either locally or globally**
- ✓ **In many cases, the production process is demanding in terms of (environmental) costs, or haulage is demanding in terms of carbon emissions. This is an area where balanced trade-offs are required**

• **Key interventions areas:**

- **Good asset management**
- **Circular economy**
- **Smart low carbon material designs**
- **Material choices and composition, incl biobased material**
- **Sourcing and repurposing extraction of material**
- **Reuse of extraction site**





9. Fostering Inclusive Growth



- ✓ Roads wire economies – yet still over 400 million of Asia’s population lacks basic road access
- ✓ Road construction and maintenance is a large public expenditure ticket – high scope for inclusive growth and jump-start fledgling economies
- ✓ In many countries, road construction is also included in social safety net programs
- ✓ Road construction can be used to build entrepreneurial capacity and – through local sourcing - to enlarge the money circulating in local economies



Fostering inclusive growth and local entrepreneurship

- Key interventions areas:
- Local sourcing
- Employment generation and local capacity building
- Promoting (safe) roadside businesses
- Ensuring last mile access
- Gender and indigenous population special inclusion



Local material processing



Trail bridge to ensure last mile access



1. Develop a Green Roads Vision for Asia

2. Take stock of most promising Green Roads practices and approaches

3. Assess the relevance and applicability of Green Roads solutions discussion in four countries

4. Develop the Green Roads Guidance Note (Assessment Tool) and Toolkit

5. Pilot test the Toolkit and Guidance Note in two projects

6. Organize the Launch of the Toolkit and Guidance Note

**Working on
Green
Roads
Toolkit and
Guidance
Note**

Working together on it

Community
of practice



Award competition:
capturing local
good practices (results known)

Green Roads Toolbox and
Guidance
Note/Assessment Tool

ADB
reference
group

Country
deep dives

Engagement at ADB

- Projects to start testing the tool
- Responses and suggestions