Sustainable and Resilient Transport Infrastructure

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UN-OHRLLS Training on Strengthening Capacity to Design and Implement Policies and Identify Solutions that Promote Transport Connectivity for the Achievement of the SDGs

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Importance of climate resilient transport infrastructure development

- Contributes to achieving SDGs target 9a:

  Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States

- Good transport connectivity and quality transport infrastructure is key to strengthening trade competitiveness of LLDCs and their socio-economic development

- Infrastructure networks will be affected by the physical impacts of climate variability and change, but will also play an essential role in building resilience to those impacts (OECD).

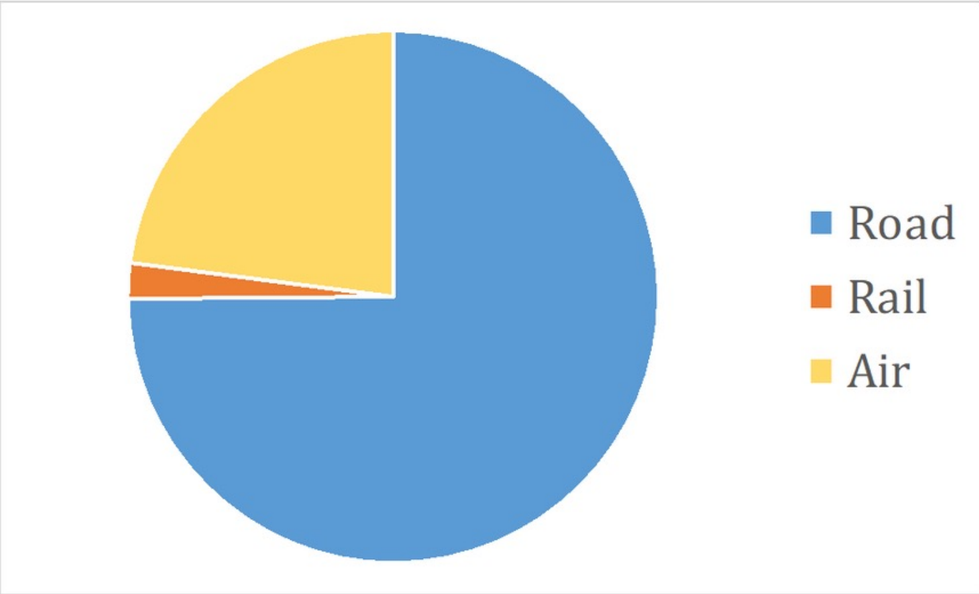
Climate change impacts in transport sector

Temperature changes	• Melting road surface and buckling railway lines. • Damage to roads due to melting of seasonal ground frostor permafrost (pavement deterioration) • Changing demand for ports as sea routes open due to melting of arctic ice
Sea-level rise	• Inundation of coastal infrastructure, such as ports, roads or railways
Changing patterns of precipitation	• Disruption of transport due to flooding • Changing water levels disrupt transport on inland waterways • Increased frequency of landslide
Changing patterns of storms	• Damage to assets such as bridges • Disruption to ports and airpots • Increased accident rates

Source : OECD

Road transport accounts for the highest freight volume in LLDCs

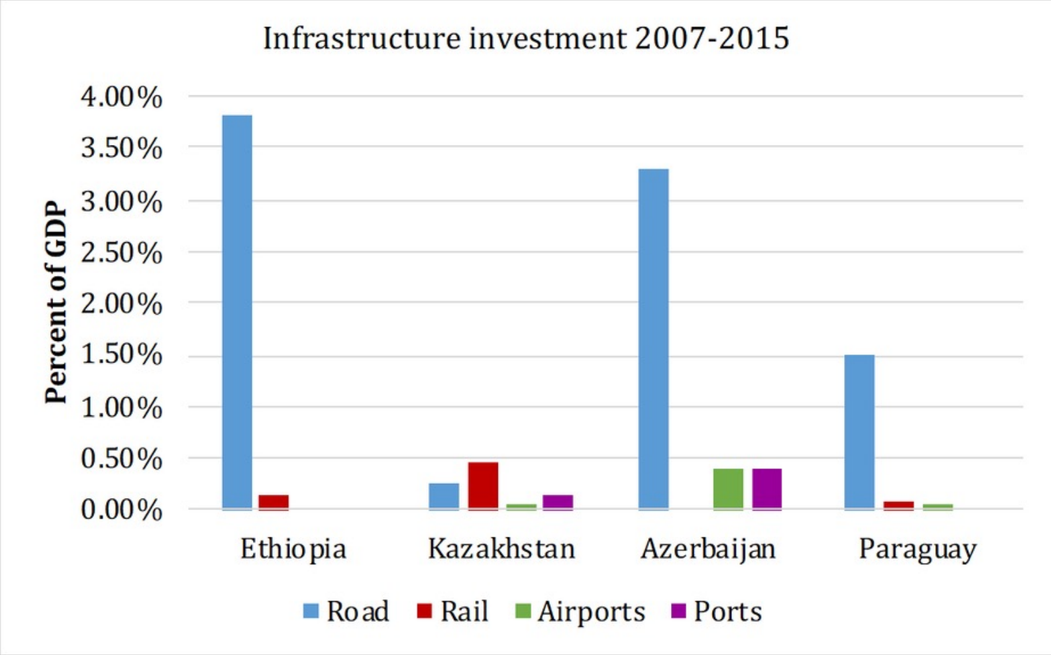
Mode share of freight transport in LLDCs in 2017

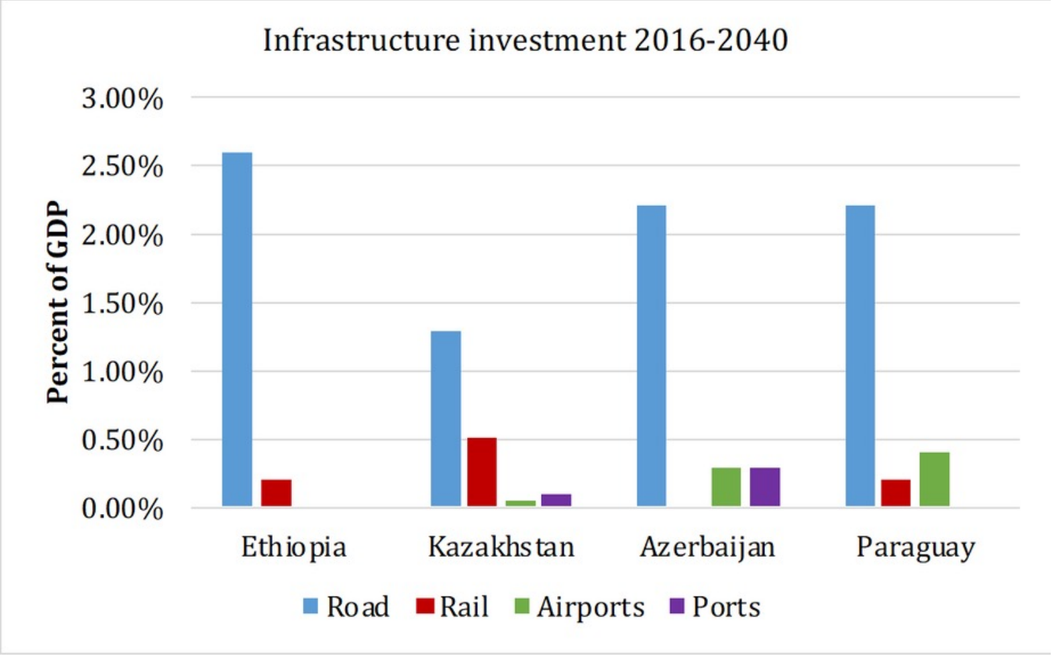


Source: United Nations SDG Indicators Database

Road sector represents a very large share of government investment

Infrastructure investment in four LLDCs



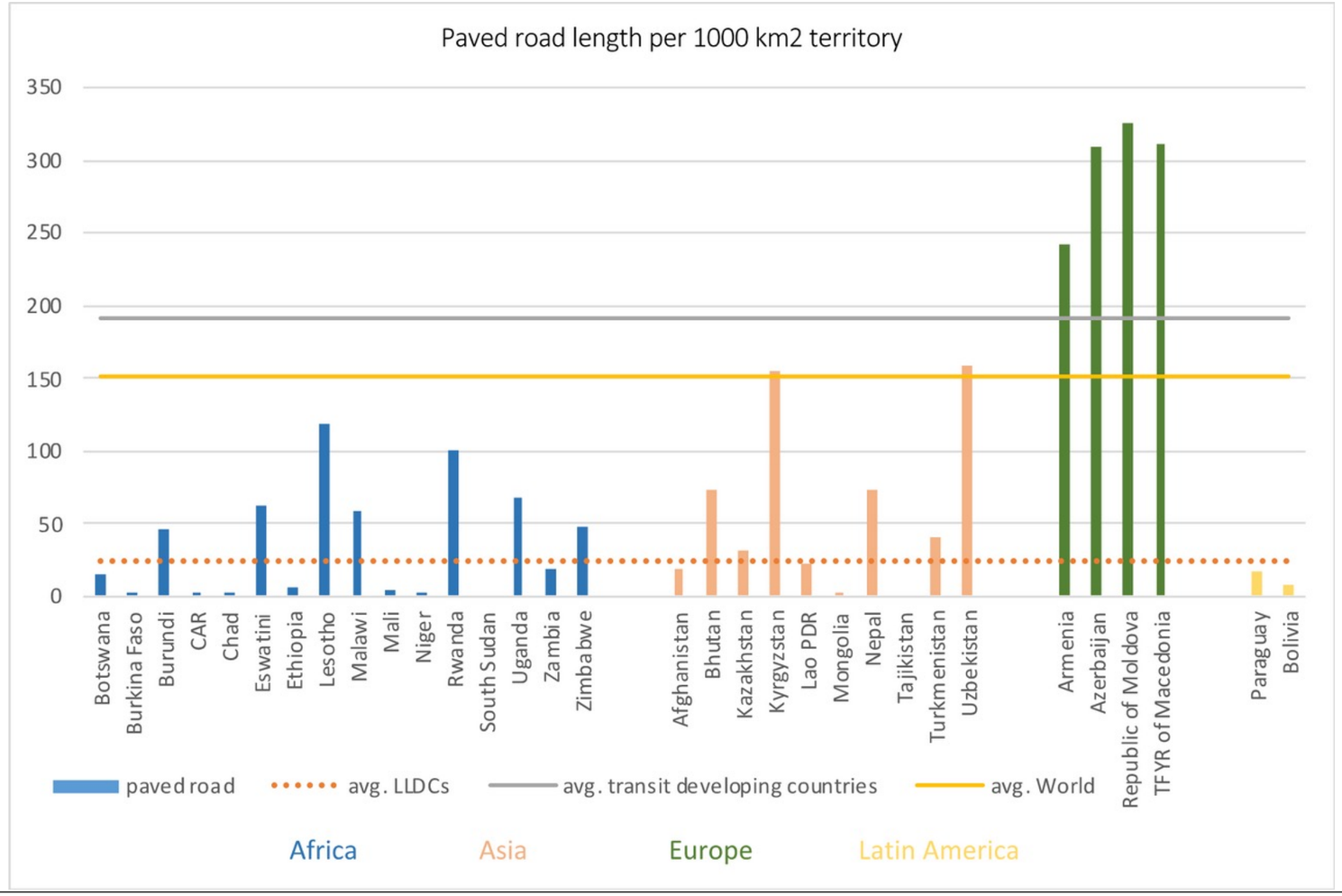


Source: Oxford Economics

- Road network is amongst the most vulnerable to climate change impacts → disruptions can lead to high economic losses
- Extreme weather puts considerable pressure on road systems → increased investments required.

Road networks of LLDCs are more vulnerable to climate change impacts

Paved road density of LLDCs



Source: UNCTAD, UN-OHRLLS

Infrastructure damage costs associated with extreme weather events

Countries	Weather event	Cost of damage to transport infrastructure (US$, millions)
Malawi	Cyclone Idai (2019)	36
Mozambique	Cyclone Idai (2019)	546
Belize	Hurricane Keith (2006)	40
Fiji	Flooding (2009)	28.5
Solomon Islands	Flooding (2014)	12

Source : USAID, Mozambique Government, World Bank

Climate change is expected to take a heavy toll on the African region’s transport infrastructure, especially roads and bridges (World Bank, 2017).

Climate resilience concept to embed into infrastructure planning

- For transport, this means
  - *Water courses are designed for more frequent flood conditions*
  - *Heavy precipitation exposes weaknesses in road and rail design and maintenance regimes*
- Public policy and regulation play a key role in enabling and promoting climate-resilient infrastructure development → necessary to develop adaptation plans to help identify entry points for mainstreaming, and promote cross-sectoral coordination
- Considering the limited funding resources channeled to transport infrastructure, the first step that can be taken by LLDCs is to make a priority list of projects based on the urgency of climate change impacts on the transport infrastructure performance.

Prioritization of Road Interventions based on Economic Development Potential and Flood Risk in MOZAMBIQUE

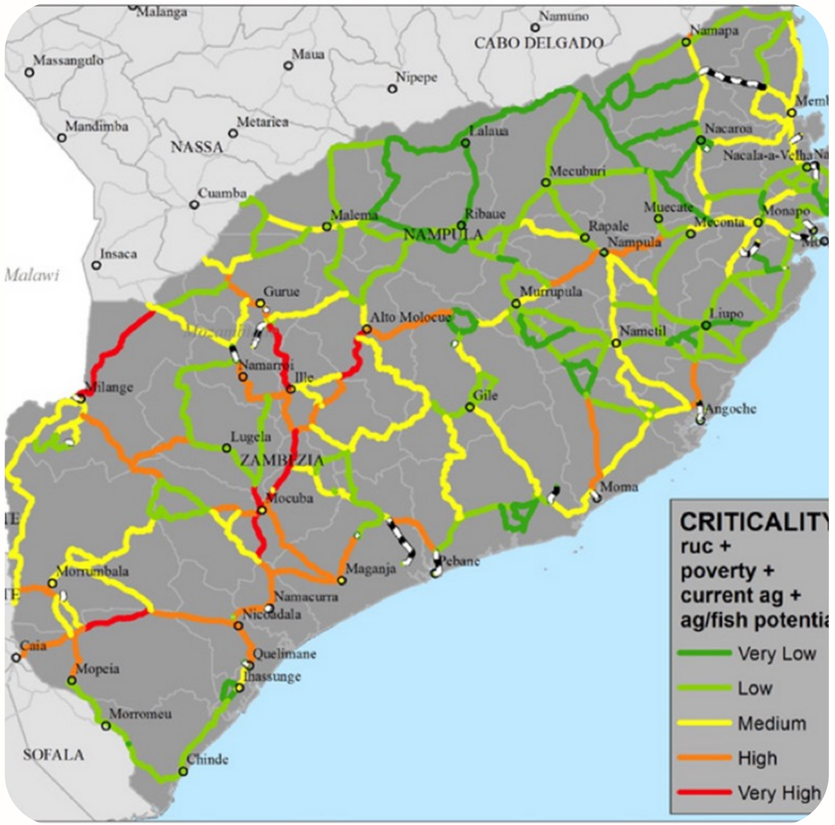
Source: https://documents1.worldbank.org/curated/en/879491510323939763/pdf/120998-PUBLIC-11-15-2017-WB-RTSIDS-Report.pdf

- Mozambique is highly exposed to flooding hazards associated with river overflow and storm surges
- The road network of Zambezia and Nampula provinces has low redundancy, resulting in disruptions that isolate communities for extended periods of time
- In order to enhance the reliability of the transport network under extreme weather conditions, the Road Authority of Mozambique assisted by the World Bank, put efforts to prioritize road investments to enhance the reliability of the transport network and to maximize transport connectivity (especially of farmers to markets)

Prioritization of Road Interventions based on Economic Development Potential and Flood Risk in MOZAMBIQUE (cont'd)

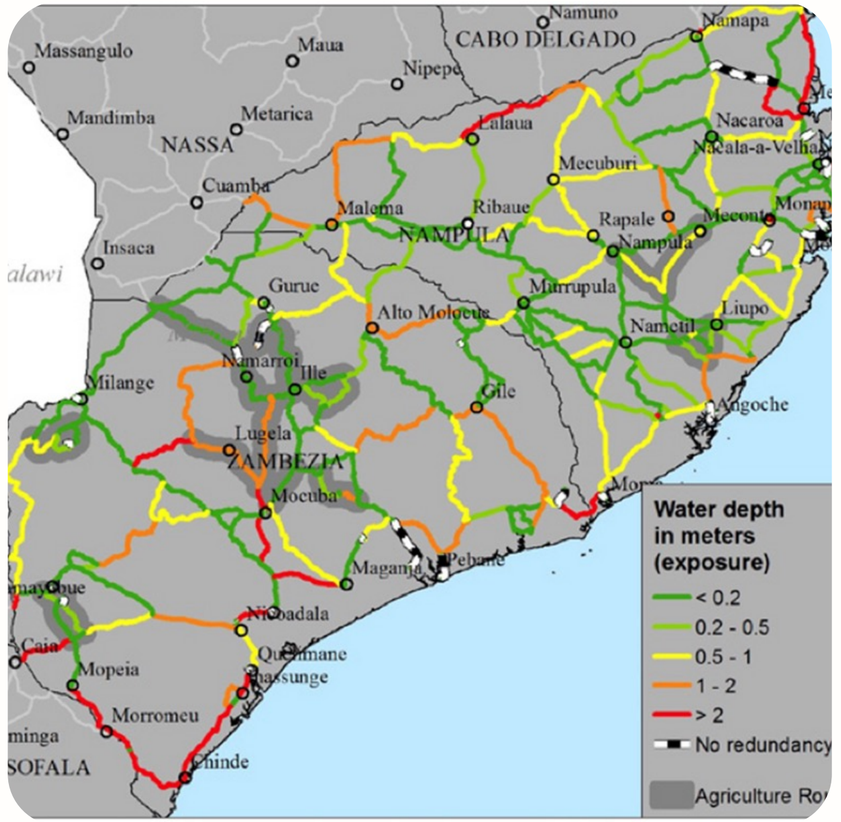
Step 1: Identifying critical and vulnerable roads using criteria:

- The loss incurred on the network performance when transport link is removed
- Proximity to potential agriculture/fisheries clusters
- Current agriculture production
- Poverty rate of adjacent districts



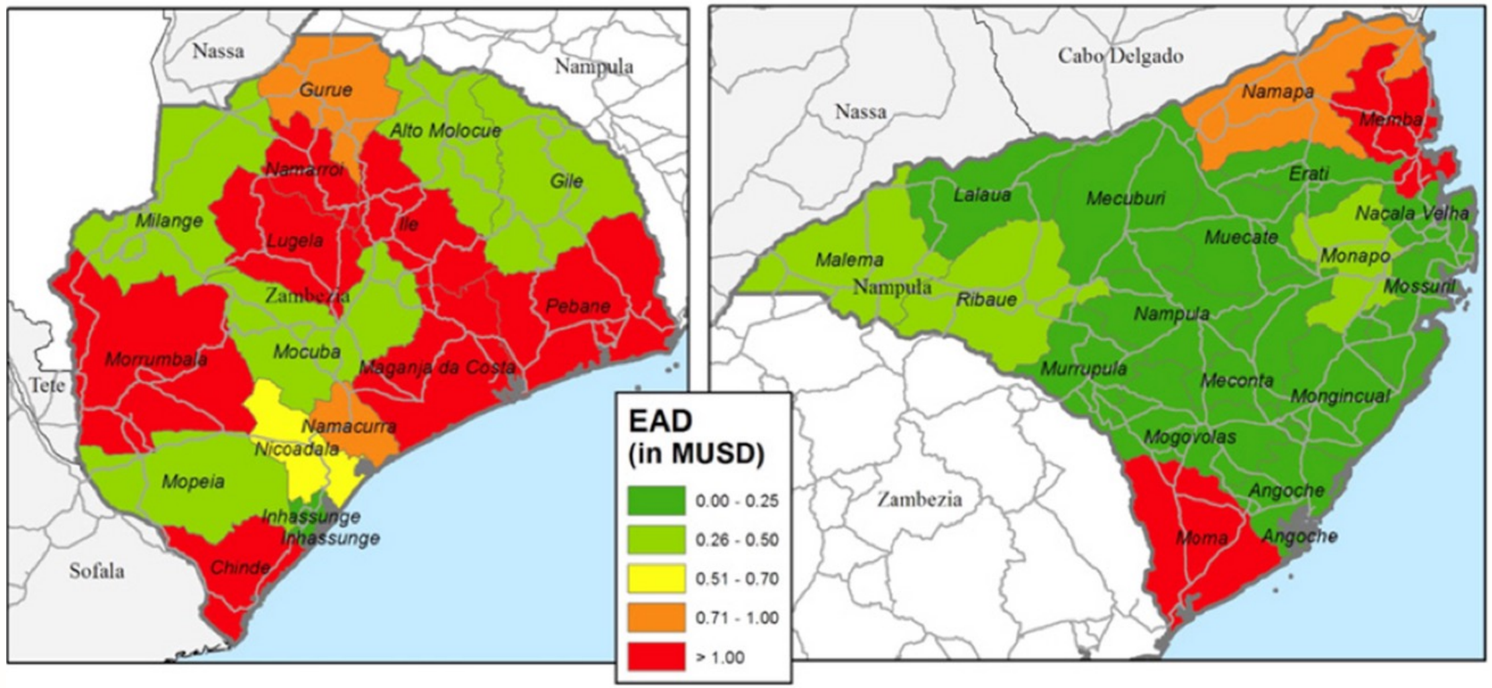
Prioritization of Road Interventions based on Economic Development Potential and Flood Risk in MOZAMBIQUE (cont'd)

Step 2: Assessing the exposure of the transport network to floods for four different climate scenarios by overlaying flood maps with transport infrastructure network



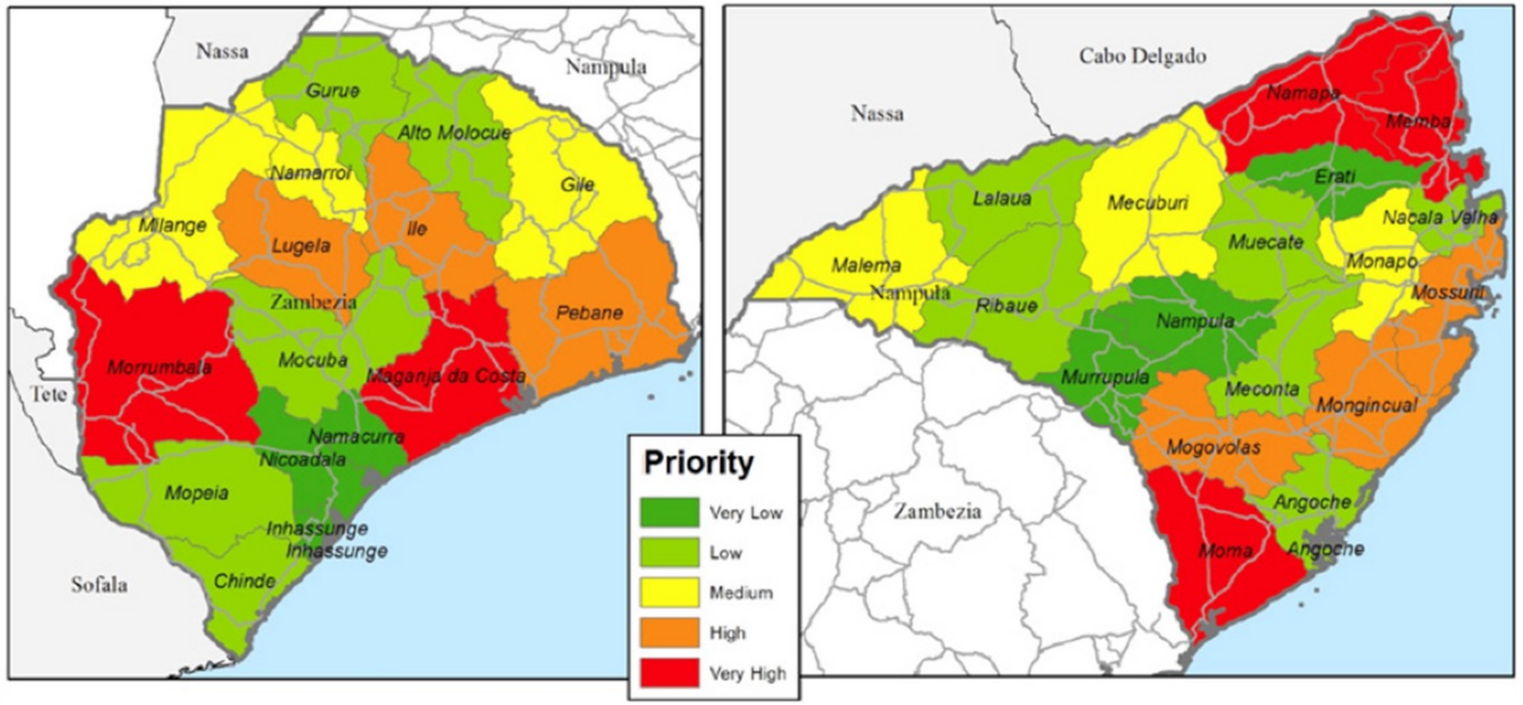
Prioritization of Road Interventions based on Economic Development Potential and Flood Risk in MOZAMBIQUE (cont'd)

Step 3: Calculating the vulnerability and hazard risk (expected annual damage to infrastructure)



Prioritization of Road Interventions based on Economic Development Potential and Flood Risk in MOZAMBIQUE (cont'd)

Step 4: prioritizing areas for intervention using a prioritization matrix that combines criticality and hazard risk. Areas with both high criticality and high risk can be prioritized for investment

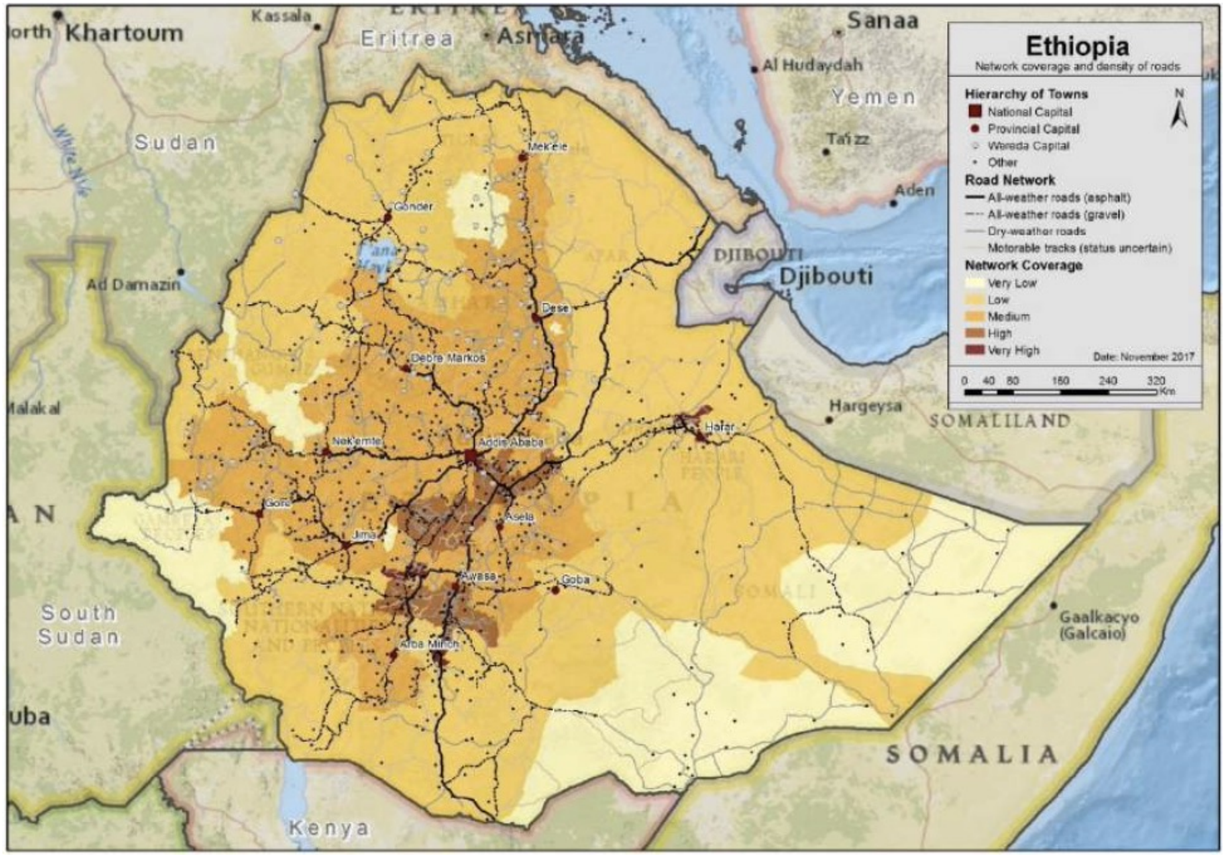


Climate Change Adaptation for Vulnerable Infrastructure in Ethiopia

Source: https://assets.publishing.service.gov.uk/media/5e185274e5274a06b3134b23/Arnoldetal-CSIR-Consortium-2018-ClimateAdaptation-EthiopiaReport-AfCAP-GEN2014C-v181221-compressed.pdf

- Ethiopia is one of the most vulnerable countries to climate change, and is frequently faced with climate-related hazards, commonly drought and floods
- The success of new roads will depend on taking into account the choice of alignment, design and construction, the climate and topography in which the road is situated (The World Bank)
- The economy relies on small road network of mostly dry-weather roads → commerce highly vulnerable to climate threats

Climate Change Adaptation for Vulnerable Infrastructure in Ethiopia (cont'd)



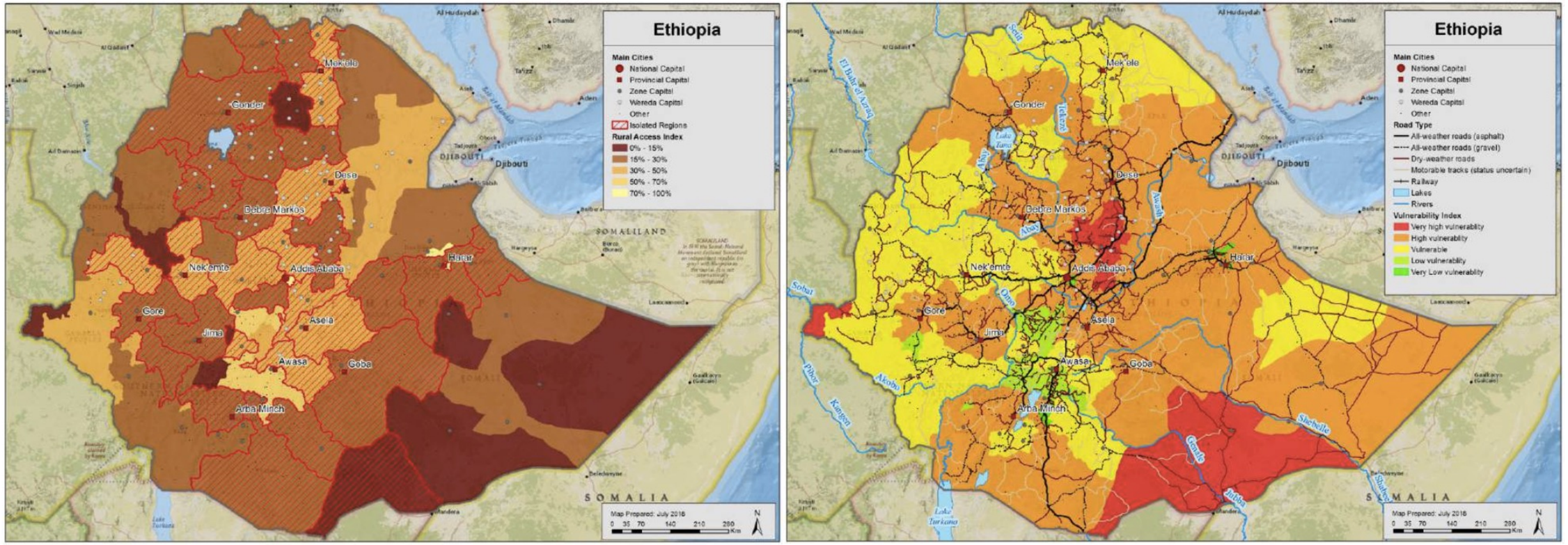
- Most all-weather roads radiate outwards from Addis Ababa to major towns → low connections between regions discourages interregional trade and 60% of rural population has no access to an all-weather road
- Higher temperatures cause pavement materials to degrade faster → earlier replacement required → higher maintenance and replacement costs

Climate Change Adaptation for Vulnerable Infrastructure in Ethiopia (cont'd)

Road vulnerability matrix (rainfall and temperature 2030) as a basis to review road design standards against known climate parameters and to assess potential impacts on existing and new roads

Infrastructure		Rainfall	Temperature
Pavements	Technical risks	Low	Medium
	Operational risks	Low	Medium
Structures	Technical risks	High	Medium
	Operational risks	High	Medium
Drainage	Technical risks	High	Low
	Operational risks	High	Low
Earthworks	Technical risks	High	Medium
	Operational risks	High	Low

Climate Change Adaptation for Vulnerable Infrastructure in Ethiopia (cont'd)



- Risk and vulnerability assessments were undertaken to identify districts where roads are most vulnerable to climate change (rural accessibility impact)
- It provides information to support the development of a climate adaptation strategy for rural access roads and to guide investment decisions

Climate Change Adaptation for Vulnerable Infrastructure in Ethiopia (cont'd)

Ethiopia's Climate Resilient Transport Sector Strategy 2018-2032

- Strengthening transport planning
  - incorporating climate change in road asset management with a particular focus on institutionalizing regular road maintenance
  - creation of an interagency coordination unit within the Ministry of Transport that will also assist to coordinate the climate resilient activities
- Storm water management to reduce the potential impact on transport infrastructure
- Ensuring good access roads to reduce social disadvantage
- Adoption of new design standards, operation and maintenance practices considering climate projection scenarios

Conclusion

- Development of climate resilient infrastructure will help reduce direct losses and economic disruption caused by climate variability and change
- Addressing climate change impacts in LLDCs' transport infrastructure planning and management is essential considering the urgency to be landlinked.
- Ensuring resilient transport infrastructure should be rooted in initial project planning to prepare for and mitigate the direct and indirect effects of climate change because infrastructure systems are interdependent, which means that climate change impacts on one infrastructure asset can cascade through the system.

Thank you for listening ...