

CLIMATE CHANGE ASSESSMENT

I. BASIC PROJECT INFORMATION

Project Title:	Maharashtra Rural Connectivity Improvement Project—Additional Financing
Project Cost (\$ million):	\$441.9 million
Location:	State of Maharashtra, Government of India
Sector:	Agriculture, Natural Resources and Rural Development
Theme:	Rural Market Infrastructure
Brief Description:	The project is aligned with the government's Vision 2030 and the country partnership strategy for India, 2018–2022 of ADB. ¹ The project will improve about 2,900 kilometers of rural roads and bridges to all-weather standards, to support rural populations across 34 districts and help bolster the agriculture sector. The project will also support the government's agricultural strategy for increasing agricultural productivity by (i) encouraging commercial agriculture and agribusiness development, (ii) increasing employment opportunities for rural poor people, and (iii) reducing the state's poverty incidence. Development of the rural road network is one critical initiative aimed at achieving the state's agriculture growth target of 5% per year. The project is included in the country operations business plan, 2020–2022 for India. ² Road infrastructure often forms the critical backbone of local economic and community activities. It enables the distribution of goods and services within and between rural areas and urban centers; and eases access to schools, markets, and health services. Changes in the variability and magnitude of temperature, precipitation, rising sea levels, and extreme weather events can affect these infrastructures if not properly sited and the designs suited to the changes in weather and climate conditions. Climate change risks could have a range of cost implications (such as maintenance costs), compounding effects (such indirect effects of severed access of the rural population living in the project areas to markets, and to social and administrative services), if not properly.

Source: Asian Development Bank.

II. SUMMARY OF CLIMATE CHANGE FINANCE

Project Financing		Climate Finance	
Source	Amount (\$ million)	Adaptation (\$ million)	Mitigation (\$ million)
Asian Development Bank			
Ordinary capital resources (regular loan)	300.00	78.64	18.01

ADF = Asian Development Fund.

Source: Asian Development Bank estimates.

¹ ADB. 2017. *Country Partnership Strategy: India, 2018–2022—Accelerating Inclusive Economic Transformation*. Manila.

² ADB. 2019. *Country Operations Business Plan: India, 2021–2023*. Manila.

III. SUMMARY OF CLIMATE RISK SCREENING AND ASSESSMENT

Trend analysis of the mean and extreme annual daily rainfall and temperature including spatial and temporal variation were carried out at the project level using World Bank's Climate Change Portal 2.0. Temperature and rainfall projection based on the Beijing Climate Center Climate System Model (bcc-csm_1). The projected change in temperature and rainfall were derived using the representative concentration pathways (RCP) 8.5. Based on projected climate change and extreme climate, the rural roads are vulnerable to flooding, extreme heat, and cyclones. Vulnerabilities of each road were confirmed through transect survey. Engineering measures were incorporated in the detailed project reports to address the vulnerabilities to enhance climate resilience.

A. Sensitivity of Project Component(s) to Climate or Weather Conditions and the Sea Level	
Construction of rural roads:	
a.	Increase of extreme hot days and heat waves: <ul style="list-style-type: none"> - deterioration of pavement integrity, such as softening, traffic-related rutting, and migration of liquid asphalt
b.	Increase in intense precipitation events <ul style="list-style-type: none"> - increase on scouring of roads - damage to road infrastructure due to landslides - overloading of drainage systems - deterioration of structural integrity of roads due to increase in soil moisture levels - changes in precipitation and water levels will impact road foundations. - increased salinity levels will reduce the structural strength of pavements and lead to precipitated rusting of the reinforcement in concrete structures.
c.	Increase of storm intensity <ul style="list-style-type: none"> - damage to road infrastructure and increased probability of infrastructure failures - increased damage to signs, lighting fixtures, and supports - stronger and/or more frequent storms will affect the capacity of drainage and overflow systems to deal with stronger or faster velocity of water flows.
Construction of bridge:	
a.	Increase of extreme hot days and heat waves <ul style="list-style-type: none"> - deterioration of pavement integrity, such as softening, traffic-related rutting, and migration of liquid asphalt - thermal expansion of bridge expansion joints and paved surfaces
b.	Increase in intense precipitation events <ul style="list-style-type: none"> - increase in scouring of bridges, and support structures - deterioration of structural integrity of bridges due to increase in soil moisture levels - stronger or faster velocity of water flows will impact bridge foundations. - increased salinity levels will reduce the structural strength of pavements and lead to precipitated rusting of the reinforcement in concrete structures.
c.	Increase of storm intensity <ul style="list-style-type: none"> - increased probability of infrastructure failures - increased threat to stability of bridge decks - increased damage to signs, lighting fixtures, and supports
Sea level rise would not affect the rural roads and bridges except for 1 rural road located at the coastal area in Konkan. Since only 1 road affected, storm surge is only considered on the assessment, which is more localized than sea level rise impacts.	
B. Climate Risk Screening	
1. Temperature and rainfall increase. Based on the Coupled Model Intercomparison Project Phase 5 (CMIP5) experiments contained in Synthesis Report No. 5 (RCP8.5 scenario), the project area will	

<p>experience a slight increase in mean temperature and an appreciable increase in average rainfall for the period 2020–2039.</p> <ol style="list-style-type: none"> Temperature increase. Projected increase in annual temperature average based on monthly projections indicated slightly higher trends in Nashik and Konkan Regions at 0.79°C with the lowest occurring in Amravati Region with 0.71°C. Highest expected temperature increases ranging from 1.1°C to 1.45°C will occur in October. These projected increases in temperature will occur slowly and at levels that would cause premature rutting of asphalt. Rainfall increase. The same model scenarios predicted precipitation increases that may cause localized flooding. Across the project regions, the month of June will experience the largest increase in rainfall ranging from 69% in Nagpur to 78% in Konkan with the potential of exceeding highest historical monthly rainfall records. Flooding. The implications of the projected increases in temperature coupled with the existing natural hazards in the project regions magnify the vulnerability of the project roads to climate change extremes. The most dominant natural hazards to the projects roads that can be exacerbated by climate change are flooding and storm surge. The districts of Thane, Palghar, and Ratnagiri have high coastal flooding hazards while the districts of Akola, Yavatmal, Nanded, Latur, Parbhani, Nagpur, Chandrapur, Wardha, Bhandara, Gadchiroli and Sangli have a chance of more than 20% of experiencing potentially damaging and life-threatening floods in the coming 10 years. <p>Risk topic. Increase on mean temperature (°C) and average precipitation, and more flooding and storm surge</p>
Climate Risk Classification: MEDIUM
C. Climate Risk and Adaptation Assessment
<p>Methodology³</p> <ol style="list-style-type: none"> Conducted climate change vulnerability assessment Conducted risk mapping using the ThinkHazard! Conducted assessment of temperature and precipitation future trend CMIP5 RCP8.5 scenario using the World Bank's Climate Change Portal Coordinated with the social assessment team and conducted transect survey of all roads in the identification of flood -prone areas based on local knowledge and inclusion in the engineering detailed project report Ensured that all initial environmental examinations and environmental management plans addressed the climate change risks and vulnerabilities and adequate budget is incorporated in the bill of quantities in the bid documents <p>Summary of the key findings from the climate risk assessment, include:</p> <ol style="list-style-type: none"> Project roads are vulnerable to flooding based on historical records and the projected increase of rainfall in areas of (i) Amaravati (Akola, and Yavatmal), (ii) Aurangabad (Nanded, Latur, and Parbhani), (iii) Konkan (Palghar, Ratnagiri, and Thane), (iv) Nagpur (Nagpur, Chandrapur, Wardha, Bhandara, and Gadchiroli), and Pune (Kolhapur, Sangli and Pune) <p>Adaptation measures included additional cross-drains and larger culverts to avoid exceeding capacity, construction of retaining walls to protect the road formation from erosion, increase the road surface elevation above current practices, construction of side drains, and retaining walls, aprons and embankment protection.</p>
D. Climate Risk Screening Tool and/or Procedure Used
<p>Sieve-mapping or map overlays using GIS of the following:</p> <ol style="list-style-type: none"> Projected change in average annual rainfall and temperature from the World Bank Climate Change Portal <p>Geographic data on the State's natural hazards like past hazardous events, human and economical hazard exposure and risk from natural hazards from tropical cyclones and related storm surges, floods, landslides and tsunamis from the ThinkHazard!.</p>

³ In 2015, ThinkHazard! project was initiated to have easier access to hazard information and risk management guidance for development sector. It is an open access website that enables users to screen potential project locations for the existence of multiple natural hazards and any impacts of their project on the local hazard.

Sources: AR5 Synthesis Report (IPCC); CMIP5 and WB Climate Change Portal 2.0; MSAAPCC, Potdar, et. al. 2019; ThinkHazard!; and State's environment report 2014.

IV. CLIMATE ADAPTATION PLANS WITHIN THE PROJECT

Adaptation Activity	Target Climate Risk	Estimated Adaptation Costs (\$ million)	Adaptation Finance Justification
Roads and bridges that are at risk from climate change variability and weather extremes will be climate proofed by installing new cross-drains, increasing sizes of culverts, construction of retaining walls, increasing the road surface elevation above flood levels, and construction of new side drains.	Climate change variability and weather extremes which increase the risk of flooding, landslides, sea level rise and storm surges.	78.64	The additional structures will address the climate risk of the project roads

Source: Asian Development Bank

Total cost of these adaptation measures is estimated at \$78.64 million. ADB will finance 100% of climate adaptation costs.

V. CLIMATE MITIGATION PLANS WITHIN THE PROJECT

Using the ADB's Transport Emissions Evaluation Model for Projects (TEEMP), the improvement in road surface will allow vehicle to travel at optimum speed which results to lower fuel consumption and lower carbon dioxide emissions. For the entire economic project life of 20 years, carbon dioxide emission reduction from road roughness improvement is estimated at 58,372 tons.

Mitigation Activity	Estimated GHG Emissions Reduction (tCO₂e/year)^a	Estimated Mitigation Costs (\$ million)	Mitigation Finance Justification
Improvements in the condition of road surfaces and improvements to regular operation and maintenance of upgraded roads.	2,919	18.01 (estimated at 4.7% of the construction which cost accounts for the road carpeting)	The project's main objective is to improve connectivity between rural habitations, productive agricultural lands and economic growth centers across the state. In doing so, the project will also improve the surface condition of rural roads. This allows road users to travel at faster speeds and avoid congestions. The net effect will be a reduction in fuel consumption by vehicles.

ADB will finance 100% of climate mitigation costs.

GHG = greenhouse gas; tCO₂e = tons of carbon dioxide equivalent.

^a Energy savings/year x emission factor = GHG emissions reduction.