Climate Adaptation of Rural Road Networks to Preserve Accessibility and Road Assets

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Climate Adaptation: Purpose of Presentation

- To present an overview of:
  - Project aim, scope and current progress
  - Climate threat and vulnerability assessment methodology
  - Linkages with Road Asset Management
  - Way forward
The Project

To provide regional guidance on the development of climate-resilient rural access in Africa through research and knowledge sharing within and between participating countries.

Phase 1: April ‘16 to February ‘17
Phase 2: May ‘17 to December ‘18
Three participating countries

Ethiopia

Ghana

Mozambique
PART 1: Demonstration of appropriate engineering and non-engineering adaptation procedures, including assessment of socio-economic impacts
- Implementation of physical demonstrators
- Monitoring and evaluation programmes
- Practical demonstrations of vulnerability assessments
- Integration of climate change in asset management systems

PART 2: Sustainable enhancement in the Capacity of the three participating countries, as well as additional AfCAP countries
- Handbook, Guidelines and associated course notes
- Practical hands-on training, train-the-trainer programmes
- Cooperation with other Development Partners

PART 3: Uptake and embedment across AfCAP partner countries
- Advice and institutional support: e.g. policies, strategies, norms & standards, asset management, environmental management
- Diffusion: Web Portal, regional seminars/workshops

PART 4: Recommendations for Phase 3
Outputs achieved thus far (Phase 2):

- **Reports:**
  - Inception Report for Phase 2
  - First and Second Quarterly Progress Reports
  - *Climate Adaptation Handbook and associated Guidelines (for trialling)*
  - Draft Country Reports on aspects of **Change Management**

- **Associated outputs:**
  - Preparation of **Briefing Notes**
  - **Vulnerability assessment tool at project-level**
  - **Design** of demonstration sections for Mohambe-Maqueze road (Mozambique)
  - Training **Workshop** held in Mozambique

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Climate Adaptation Handbook and associated Guidelines

Adaptation Handbook Methodology

1 Climate risk screening (National/Regional)
2 Impact and vulnerability assessment (Project)
3 Technical/economic evaluation of options
4 Project design and implementation
5 Monitoring and evaluation

Change Management Guidelines
Risk/Vulnerability Guidelines
Engineering Guidelines

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be avoided, steps need to be taken to ensure that the road infrastructure can withstand the projected changes. For example, the potential for increased flooding might be a reason to increase bridge elevations beyond what historic data might suggest.

Secondly, the result of adaptive action either decreases a system’s vulnerability to changed conditions or increases its resilience to negative impacts. For example, increasing temperatures could cause pavements on the highway system to fail sooner than anticipated. Using different materials or different approaches that recognize this vulnerability can lead to pavements that will survive expected higher temperatures better.

With respect to resilience, operational improvements could be made to enhance detour routes around flood-prone areas. Another example of resiliency is well-designed emergency response plans, which can increase resilience by quickly providing information and travel alternatives when roads are closed and by facilitating rapid restoration of damaged structures. By increasing system resilience, even though a particular facility might be disrupted, the road network as a whole still functions.

The following are the primary engineering options:

- Subsurface conditions - the stability of any type of infrastructure depends on the materials on which it is built (subgrade). An important factor pertains to the degree of soil saturation, fluctuations in moisture content and the expected behaviour of the soil under saturated conditions.

- Material specifications - materials of appropriate quality must be used in both unpaved and paved roads and unsuitable materials may have to be enhanced or protected to preserve the expected lifetime of the road or structure.

- Cross section and standard dimensions - Standards may need to be revised, for example, to increase the crossfall of pavements in areas where one can expect a greater need to remove more water from the road. Similarly, standards (or guidelines) pertaining to road elevations or the vertical clearance of bridges may have to be revised upward.

- Drainage and erosion - upgraded standard designs pertaining to drainage systems, open channels, pipes, culverts and surfacing

options (e.g. for steep hill road sections) are needed to reflect changes in future expected runoff or water flow and consequent potential for damage caused by erosion. Improved protection measures may be required.

- Protective engineering structures - can be used to address rivers in spate, rising sea levels and storm surges. These may include drifts, dykes, seawalls, rocky aprons and breakwater systems.

- Maintenance – it is essential that all aspects of maintenance related to roads, drains and structures are diligently and timely addressed. Most problems will be precluded by good maintenance.

### General Guidance / Instructions

#### Recommendations / Actions

**Recommended actions for developing implementation plan:**

- Reduce vulnerability by avoiding, reducing or taking advantage of impacts
- Take steps to ensure that the road infrastructure can withstand the projected changes
- Enhance detour and emergency response plans
- Follow primary engineering options set out above

#### References to Guidelines

This option is covered in more detail in Sections A.3.2: Do minimal or do nothing and in Section B.3.3: Socio-economic analysis of ‘do something’ and ‘do nothing’ Climate Adaptation Handbook
Climate Threats and Vulnerability Assessment Guidelines:

- One of three guidelines that form the Climate Adaptation Handbook
  - Informs in parts both the engineering and change management guidelines

- Guidance for conducting district-level climate screening and for local road climate vulnerability assessment

- Includes recommendations on geospatial data sources
  - Open global geospatial data repositories
  - Databases within a country’s government departments and agencies
  - Additional local data collection through field surveys
Purpose of the Rural Road Climate Vulnerability Assessment

- **Climate change impacts**
  - (long-term trends & extremes)
  - Quantify the impact of (increased) climate-related stresses on rural roads

- **Rural population growth**
  - Quantify the effects of climate impacts in tandem with unfavourable land-use practices and population growth
  - Inform inferences drawn about the societal and economic criticality of rural access roads

Typical problems on gravel road networks
Stage 1:
Regional level climate risk screening for rural road infrastructure
Stage 2: Project Level

Step 1.1: Identify current hazards affecting vulnerability of roads within a district (based on historical data)

Step 1.2: Understand how future hazards will likely affect the vulnerability of roads within a district (based on projected data)

Step 2.1: Local data collection
- Climate Threats Data
- Environmental Data
- Road Network Data
- Socio-economic Data

Step 2.2: Data preparation
- Climate Threats Data
- Environmental Data
- Road Network Data
- Socio-economic Data

Step 3.1: Hydrological model (catchment)

Step 3.2: Determine road exposure to specific threats

Step 3.3: Evaluate criticality of road (current socio-economic situation, future population change)

Road adaptation according to prioritization (Refer: Engineering and Change Management Guidelines)
Hydrology and Local Climate Threats

Environmental Context

Physical Road Network

Socio-Economic Context

Local level vulnerability assessment data and analysis domains
Adaptation Planning

The information and maps generated from the vulnerability assessment (Stages 1 and 2) should be used to inform current and future challenges along a corridors or particular roads that require attention:

- Stakeholders would have the necessary information to more clearly decide on the prioritisation of engineering interventions to sustain socio-economic imperatives.
- Information gathered and created during the assessments can be extracted as inputs for deriving road engineering design parameters to support sustainable road preservation in line with the above.

The above information and maps should be embedded in asset management systems to inform short and long-term investment decisions, given the scarce financial resources available.
Linkages with Asset Management
Visual assessments

- Should not only focus on the present ‘condition’ of the asset, but also on identifying potential threats and the ‘capacity’ of road assets to resist climate stressors:
  - Land-use practices (e.g. deforestation)
  - Drainage efficiency in the road reserve
  - Drainage from outside the road reserve (e.g. size and nature of the catchment area; capacity and condition of culverts and water-crossings; potential for accumulation of debris)
  - Slope stability
  - Erosion potential
  - Subgrade material problems
  - Construction quality; and
  - Maintenance effectiveness

- This may necessitate a different visual assessment team (e.g. hydrologist, geotechnical engineer, structural engineer)
Scour damage observed during visual assessment
Result after flood event
Visual assessments

- Team should assess likelihood and impact of climate events

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<th>Impact</th>
<th>Rating</th>
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<tr>
<td>R = Rare</td>
<td>1</td>
<td>N = Negligible</td>
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<tr>
<td>U = Unlikely</td>
<td>2</td>
<td>L = Low</td>
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<tr>
<td>P = Possible</td>
<td>3</td>
<td>M = Medium</td>
<td>3</td>
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<tr>
<td>L = Likely</td>
<td>4</td>
<td>V = Very High</td>
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<tr>
<td>A = Almost Certain</td>
<td>5</td>
<td>E = Extreme</td>
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- Feed back into the Asset Management System for prioritisation (maintenance/upgrading) and programming
Climate Change Events and Asset Management

- Climate change events could lead to **unexpected impacts** on the road infrastructure
- **Visual assessments** and **Road Asset Management Systems** themselves can provide the mechanisms for planning to deal with these “unexpected” impacts
- This requires actions to **integrate climate change in Asset Management Activities**
Way Forward

- Workshops and Demonstrations:
  - In-country hands-on training Workshops (Handbook/Guidelines):
    - Ethiopia: 7-8 December 2017
    - Ghana: by end January 2018
  - Demonstration sections (construction):
    - Mozambique: end-March 2018
    - Ghana: end-July 2018
    - Ethiopia: (to be determined)
  - Change Management (consultation/embedment – January/February 2018):
    - Workshops on Policies, Strategies and Plans in the three participating countries
    - Embedment of vulnerability assessment and climate-related asset management considerations at country level

- Updating of Handbook and Guidelines (February 2018) & posting on ReCAP website (March 2018)
- Implementation of Train-the-Trainer programmes
- Wider dissemination of knowledge at regional events
Thank you for your attention

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