



AfCAP
Africa Community Access Partnership



Climate Adaptation: Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa

Workshops held in Mozambique, Ghana and Ethiopia



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AfCAP Project GEN2014C

February 2017



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<i>Quality assurance and review table</i>			
Version	Author(s)	Reviewer(s)	Date
1	B Verhaeghe, M Head, S Makhanya, P Paige-Green	L Sampson, Dr J Cook	16 February 2016

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Abstract

The African Development Bank states that Africa is one of the most vulnerable regions in the world to the impacts of climate change. The majority of both bottom up and top down studies suggest that damages from climate change, relative to population and Gross Domestic Product, will be higher in Africa than in any other region in the world. In the past four decades, African countries have experienced more than a 1,400 recorded weather related disasters (meteorological, hydrological and climatological). These disasters have resulted in the death of more than 600,000 people (95 per cent due to droughts), left 7.8 million people homeless (99 per cent due to flooding and storms) and affected an estimated 460 million people.

In order to help address this significant threat to Africa's development, the Africa Community Access Partnership, a research programme funded by UKAid, commissioned a two-phased project that starting in April 2016 to produce regional guidance on the development of climate-resilient rural access in Africa through research and knowledge sharing within and between participating countries. The output will assist the development of a climate resilient road network that reaches fully into and between rural communities.

The study addresses the issues of appropriate and economic methodologies for vulnerability and risk assessments; prioritisation of adaptation interventions; and optimisation of asset resilience in the context of low volume rural access roads. In addition, evidence of cost, economic and social benefit links to rural communities arising from more resilient rural access will be provided to support wider policy adoption across Africa.

The aim of Phase 1 of this study is to provide methodologies and guidance on the assessment of climate threats and for the identification and prioritisation of adaptation options. These are contained in two reports, namely a *Climate Threats Report* and a *Climate Adaptation Options Report*.

A further aim of Phase 1 is to provide the basis for the implementation of demonstration sections in three countries, namely Ethiopia, Ghana and Mozambique, and to present recommendations for Phase 2 of this study. Draft recommendations are contained in the report *Recommendations for Phase 2*, which focusses on: (a) demonstrating appropriate engineering and non-engineering adaptation procedures; (b) sustainable enhancement in the capacity of three AfCAP partner countries; (c) sustainable enhancement in the capacity of additional AfCAP partner countries; and (d) uptake and embedment across AfCAP partner countries.

The guideline documents as well as the recommendations for the implementation of demonstration sections and the proposed recommendations for Phase 2 of the study were debated at workshops held in January and February 2017 in these three countries. The outputs of these workshops will define the objectives and scope for Phase 2 with will be outlined in the Final Report for Phase 1.

Key words

Capacity Building; Climate Adaptation; Climate Change; Climate Impact; Climate Resilience; Climate Threat; Climate Variability; Demonstration; Risk; Rural Access Road; Vulnerability; Workshops.

AFRICA COMMUNITY ACCESS PARTNERSHIP (AfCAP)
Safe and sustainable transport for rural communities

AfCAP is a research programme, funded by UK Aid, with the aim of promoting safe and sustainable transport for rural communities in Africa. The AfCAP partnership supports knowledge sharing between participating countries in order to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources. AfCAP is brought together with the Asia Community Access Partnership (AsCAP) under the Research for Community Access Partnership (ReCAP), managed by Cardno Emerging Markets (UK) Ltd.

See www.research4cap.org

Glossary (within the context of this project)

Adaptation	Autonomous or policy-driven adjustments in practices, processes or structures to take account of changing conditions.
Adaptive Capacity	The degree to which adjustments in practices, processes and structures can moderate or offset the potential for damage or take advantage of opportunities created by a given change [in climate].
Adaptation Needs	The circumstances requiring actions to ensure safety of populations and security of assets in response to climate impacts.
Adaptation Options	The array of strategies and measures that are available and appropriate for addressing adaptation needs. They include a wide range of actions that can be characterised as structural, institutional, or social.
Capacity Building	The ability of enhancing strengths and attributes of. And resources available to, an individual community, society, or organisation to response to change.
Climate Change	Change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.
Climate Variability	Variations in the mean state and other statistics of the climate on all spatial and temporal scales beyond those of individual weather elements. Variability may be due to natural internal processes within the climate system (internal variability) or to variations in natural or anthropogenic external forcing (external variability).
Disaster	Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.
Early Warning Systems	The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organisations threatened by a hazard to prepare to act promptly and appropriately to reduce the possibility of harm or loss.
Exposure	The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.
Extreme Weather Events	An event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).
Flood	The overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods, and glacial lake outburst floods.

Hazard	The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. In this report, the term hazard usually refers to climate-related physical events or trends or their physical impacts.
Impacts (Consequences, Outcomes)	Effects on natural and human systems. In this report, the term <i>impacts</i> is used primarily to refer to the effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. Impacts are also referred to as consequences and outcomes. The impacts of climate change on geophysical systems, including floods, droughts, and sea level rise, are a subset of impacts called physical impacts.
Impact Assessment	The practice of identifying and evaluating, in monetary and/or nonmonetary terms, the effects of [climate] change on natural and human systems.
Likelihood	The chance of a specific outcome occurring, where this might be estimated probabilistically.
Mitigation	The lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability.
Resilience	The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.
Risk	The potential for consequences where something of value is at stake and where the outcome is uncertain, recognising the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. In this report, the term 'risk' is used primarily to refer to the risks of climate impacts.
Risk Assessment	The qualitative and/or quantitative scientific estimation of risks.
Risk Management	Plans, actions, or policies to reduce the likelihood and/or consequences of risks or to respond to consequences.
Stressors	Events and trends, often not climate-related, that have an important effect on the system exposed and can increase vulnerability to climate related risk.
System Sensitivity	The degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.
Vulnerability Assessment	Process which attempts to identify the root causes for a system's vulnerability [to climate variability and change].

Acronyms, Units and Currencies

\$	United States Dollar
°C	Degrees Celsius
AfCAP	Africa Community Access Partnership
ADB	Asian Development Bank
ANE	Administração Nacional de Estradas (National Roads Administration, Mozambique)
ARTReF	African Road and Transport Research Forum
AsCAP	Asia Community Access Partnership
CSIR	Council for Scientific and Industrial Research, South Africa
DANIDA	Danish International Development Agency
DFID	Department for International Development, UK
DFR	Department of Feeder Roads (Ghana)
DIMAN	Direcção de Manutenção (ANE)
DIPLA	Direcção de Planificação (ANE)
DIPRO	Direcção de Projectos (ANE)
EDF	European Development Fund
EIA	Environmental Impact Assessment
ERA	Ethiopian Roads Authority
EU	European Union
GIS	Geographic Information System
JICA	Japan International Cooperation Agency
KTC	Kofovidua Training Centre (Ghana)
LVR	Low Volume Road
MESTI	Ministry of Environment, Science, Technology and Innovation (Ghana)
MRH	Ministry of Roads and Highways (Ghana)
NDP	Nordic Development Fund
RAMS	Road Asset Management System
ReCAP	Research for Community Access Partnership
RSDP	Road Sector Development Plan (Ethiopia)
SADC	Southern African Development Community
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)
UN	United Nations
URRAP	Universal Rural Road Access Program (Ethiopia)

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1. Executive Summary

The African Development Bank states that Africa is one of the most vulnerable regions in the world to the impacts of climate change. The majority of both bottom up and top down studies suggest that damages from climate change, relative to population and Gross Domestic Product, will be higher in Africa than in any other region in the world. In the past four decades, African countries have experienced more than a 1,400 recorded weather related disasters (meteorological, hydrological and climatological). These disasters have resulted in the death of more than 600,000 people (95 per cent due to droughts), left 7.8 million people homeless (99 per cent due to flooding and storms) and affected an estimated 460 million people.

In order to help address this significant threat to Africa's development, the Africa Community Access Partnership, a research programme funded by UKAid, commissioned a two-phased project that starting in April 2016 to produce regional guidance on the development of climate-resilient rural access in Africa through research and knowledge sharing within and between participating countries. The output will assist the development of a climate resilient road network that reaches fully into and between rural communities.

The study addresses the issues of appropriate and economic methodologies for vulnerability and risk assessments; prioritisation of adaptation interventions; and optimisation of asset resilience in the context of low volume rural access roads. In addition, evidence of cost, economic and social benefit links to rural communities arising from more resilient rural access will be provided to support wider policy adoption across Africa.

The aim of Phase 1 of this study is to provide methodologies and guidance on the assessment of climate threats and for the identification and prioritisation of adaptation options. These are contained in two reports, namely a *Climate Threats Report* and a *Climate Adaptation Options Report*.

A further aim of Phase 1 is to provide the basis for the implementation of demonstration sections in three countries, namely Ethiopia, Ghana and Mozambique, and to present recommendations for Phase 2 of this study. Draft recommendations are contained in the report *Recommendations for Phase 2*, which focusses on: (a) demonstrating appropriate engineering and non-engineering adaptation procedures; (b) sustainable enhancement in the capacity of three AfCAP partner countries; (c) sustainable enhancement in the capacity of additional AfCAP partner countries; and (d) uptake and embedment across AfCAP partner countries.

The guideline documents as well as the recommendations for the implementation of demonstration sections and the proposed recommendations for Phase 2 of the study were debated at workshops held in January and February 2017 in the three countries. The outputs of these workshops will define the objectives and scope for Phase 2, which will be outlined in the Final Report for Phase 1.

2. Introduction to the Programme

In order to help address a significant climate impact to Africa's development, a consortium led by CSIR (South Africa's Council for Scientific and Industrial Research), has been commissioned by AfCAP to produce regional guidance on the development of climate-resilient rural access in Africa through research and knowledge sharing within and between participating countries. The output will assist the development of a resilient, future-climate-proof road network that reaches fully into and between rural communities.

2.1 Overall aim of the Programme

The overall aim of the Programme is to move forward from previous AfCAP research and deliver sustainable enhancement in the capacity of AfCAP Partner Countries to reduce current and future climate impacts on vulnerable rural infrastructure. This is to be achieved through the research and consequent uptake and embedment, at both policy and practical levels, of pragmatic, cost-beneficial engineering and non-engineering procedures based on the recognition of locally-specific current and future climate threats.

2.2 Overall objectives

The fundamental research objective is to identify, characterise and demonstrate appropriate engineering and non-engineering adaptation procedures that may be implemented to strengthen long-term resilience of rural access based on a logical sequence of defining:

- Climate threats
- Climate impacts
- Vulnerability to impact (risk)
- Non-engineering adaptations
- Engineering adaptations
- Prioritisation

The second objective, which focusses on capacity building and knowledge exchange, is to meaningfully engage with relevant road and transport Ministries, Departments and Agencies/Authorities in a knowledge dissemination and capacity building programme based on the outputs from the research.

The third objective is to ensure that there is focus on uptake and subsequent embedment of outcomes aimed at a range of levels from informing national policies, through regional and district planning, down to practical guidance on adaptation delivery at rural road level.

2.3 Progress to date (Phase 1)

The focus of Phase 1 of the Programme was primarily on the establishment of a solid basis for Phase 2 through research and knowledge exchange. A further aim of Phase 1 was to provide the basis for the implementation of demonstration sections in three countries, namely Ethiopia, Ghana and Mozambique, and to deliberate the guideline documents produced to date, as well as the recommendations for the implementation of demonstration sections, at workshops held in these three countries.

Two main reports have been produced in Phase 1, as follows:

1. The *Climate Threats Report* (July 2016) addresses how the threats can be assessed, characterised and prioritised. It presents a review of the current and future climate threats and their likely impacts to rural road networks.

2. The *Climate Adaptation Options Report* (September 2016) provides a methodology for developing an adaptation strategy and addresses engineering and non-engineering adaptation options. The crucial importance of effective drainage is highlighted and also the critical need for timely and appropriate maintenance.

2.4 Phase 2 Recommendations for discussion

Phase 1 produced a third report, namely *Recommendations for Phase 2* (December 2016). This report contains preliminary recommendations for the climate adaptation of three roads, one in each of the three countries (Ethiopia, Ghana and Mozambique). These roads, which will form the basis of the demonstration programme, are representative of the range of potential hazards that low volume access roads are likely to be exposed to in AfCAP Partner Countries. The roads were selected following site visits undertaken in these three countries. The report also contains field notes on other roads inspected during these visits.

The report also presents preliminary recommendations for Phase 2 of the study, focussing on:

- a) Demonstrating appropriate engineering and non-engineering adaptation procedures, and the assessment of the socio-economic impacts of adopting more climate resilient adaptations;
- b) Sustainable enhancement in the capacity of three AfCAP partner countries;
- c) Sustainable enhancement in the capacity of additional AfCAP partner countries; and
- d) Uptake and embedment across AfCAP partner countries.

3. Structure of the Workshops

3.1 Objectives of the Workshops

The Workshops had two primary objectives:

- (a) to sensitise and brief the Workshop delegates on climate threats and their impacts on vulnerable rural access, and on how these could be addressed through the implementation of engineering and non-engineering adaptation options, within a framework of applicable vulnerability assessment and climate adaptation methodologies;
- (b) to identify specific country needs and requirements so as to enable AfCAP to formulate appropriate support programmes to capacitate the countries and to assist them with the uptake and embedment of the outcomes in, for instance, policies, planning (e.g. through road asset management systems), norms and standards.

Objective (a) formed the basis of the discussions on the first day of the workshops held in Mozambique, Ghana and Ethiopia. The two reports listed in Section 2.3 ("*Climate Threats Report*" and "*Climate Adaptation Options Report*") were used as a starting point for ensuing discussions.

The "*Recommendations for Phase 2*" Report (Section 2.4) formed the basis for discussion on *Objective (b)* above. These took place on the second day of the workshops.

Overall, the outputs of these workshops will define the objectives and scope for Phase 2 of the Climate Adaptation Programme, which main focus will be on the practical demonstration of engineering and non-engineering adaptations; capacity building; and the uptake and embedment of outcomes.

3.2 Abridged Workshop programme

Three workshops were held in quick succession of each other, namely:

- **Mozambique:** held in the Conference Room of ANE in Maputo on 30 and 31 January 2017;
- **Ghana:** held at the Engineering Centre of the Ghana Institution of Engineers in Accra on 2 and 3 February 2017; and
- **Ethiopia:** held at the Alemgena Training Centre, south of Addis Ababa, on 8 and 9 February 2017.

The workshops in each of the three countries were conducted over a period of two days. **The first day** of workshops was structured (in broad terms) according to the logical sequence outlined in Section 2.2 (the names of presenters are shown in brackets; a detailed Workshop programme is provided in Annex A):

DAY 1:

- Overview of ReCAP (*Mr L Sampson: Mozambique and Ethiopia; Dr J Cook: Ghana*)
- Introduction to the AfCAP Climate Adaptation project (*Mr B Verhaeghe*)
- Overview of climate threats and impacts at regional and country level (*Ms S Makhanya*)
- Overview of vulnerability assessment and adaptation methodologies:
 - Vulnerability assessment (*Ms S Makhanya*)
 - Prioritisation at network level (i.e. road asset management systems) (*Mr M Head*)
 - Adaptation methodology at project level (*Mr M Head*)
- Overview of adaptation options:
 - Engineering adaptation options (*Dr P Paige-Green*)
 - Non-engineering adaptation options (*Mr M Head*)

The focus of the **second day** of the workshops was on the capturing of country-specific needs that would inform project activities that would be included and programmed in Phase 2 of the study:

DAY 2:

- Feedback on site visits and on the proposed demonstration site (*Dr P Paige-Green*)
- Recommendations for Phase 2 of the AfCAP Climate Adaptation project (*Mr M Head*)
- Workshop summary (*Mr B Verhaeghe*)

The facilitators for the three workshops were as follows:

- **Mozambique:** Messrs N Leta (AfCAP Regional Manager) and B Verhaeghe (AfCAP Consultant)
- **Ghana:** Dr J Cook (ReCAP Team Leader)
- **Ethiopia:** Mr L Sampson (ReCAP Infrastructure Research Manager)

4. Synthesis of the presentations

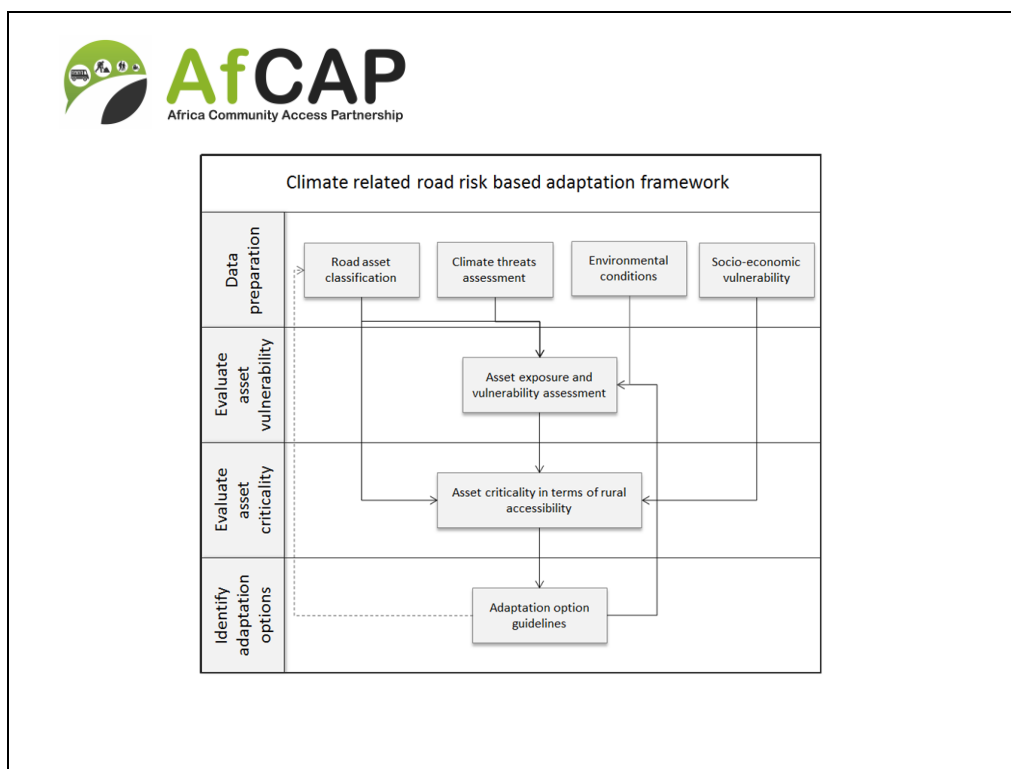
In addition to the introductory and summary presentations, each workshop included seven technical presentations addressing different aspect of the AfCAP Climate Adaptation study. The presentations were interlaced with discussions and debates on the various issues.

On **Day 1**, the workshops were opened with an overview of the ReCAP programme, addressing the aims and envisaged outcomes of the programme; highlighting the need for uptake and embedment of programme outputs; and providing an overview of the Infrastructure Research, Transport Services and Cross-Cutting Themes and their associated projects.

This was followed by a general overview of the Climate Adaptation programme of activities, in which the aims and objectives; the methodology that was followed; an overview of progress achieved to date, as well as an overview of the workshop programme, were presented.

The first technical presentation was on regional and country-specific climate variability and change, and the association thereof with rural access vulnerability. It dealt with observed trends in temperature and rainfall, observed impacts of weather related disasters and projections of future climate change.

Immediately following on to the above, a vulnerability assessment methodology, inclusive of risk assessment input data components, was tabled for discussion (see Figure below). The practical implementation of this methodology using Mozambique as a case study was demonstrated.



Vulnerability assessment methodology

In the next presentation, an approach for incorporating climate change considerations in all system components of a Road Asset Management System (RAMS) to support prioritisation and decision making was presented. This was followed by outlining an adaptation methodology, consisting of six activity stages and a 20-step process, for the implementation of climate resilience at project level.

The following two presentations addressed the engineering and non-engineering adaptation options. With respect to the engineering adaptation options, a comprehensive overview was provided on:

- a. possible climate-related problems and damages that could impact on facilities (e.g. road pavements, earthworks, subgrade soils, drainage structures), as well as on operations (e.g. construction and maintenance), and
- b. adaptation measures that could be considered for implementation.

As regards the non-engineering adaptation measures, a significant number of options were presented, ranging from modification to policies and plans to augmentation of norms and standards. These options formed the basis for discussion on the countries' priorities with respect to the options presented.

Day 2 of the Workshops focused on mapping the road ahead in terms of Phase 2 of the AfCAP Climate Adaptation programme. The day started off with a presentation on the visits that were undertaken in 2016 to roads in Ethiopia, Ghana and Mozambique that were identified by the road authorities in the three countries as potential candidates for the establishment of climate adaptation demonstration sections. An overview was presented on what was observed on the roads and general recommendations for adaptation were provided. This was followed up by more detailed feedback on the adaptation recommendations for the three roads selected for the demonstrators.

In the final presentation, the proposed objectives and scope for Phase 2 of the Programme were tabled, followed by extensive discussion on the particular needs of the country in terms of demonstrations, capacity building, advice and technical assistance that would support the implementation, uptake and embedment of climate adaptation in all activities of road authorities.

A Workshop Summary was presented at the end of the workshop, reflecting back on the main issues that were debated and recommendations that were tabled. A summary of the main discussion points are provided in Section 5.

All presentations can be downloaded from the Project's webpage on the ReCAP website¹.

5. Outputs summary

In the sections below, an overview of the main discussion topics (per country) are presented. Whereas the comments made by the workshop participants were highly appreciated, they may represent particular viewpoints which will be taken into consideration but may not necessarily all be adopted.

5.1 Mozambique

5.1.1 Introductions

The Workshop was opened by Mrs Irene Simões, Director of the Direcção de Manutenção (Directorate of Maintenance) of the Administração Nacional de Estradas (ANE). The Director noted the urgency required to address the impacts of climate (e.g. riverine flooding) on road infrastructure, including rural access roads. She also pointed out that the AfCAP programme should not only focus on the Province of Gaza, but also address climate-related problems that are frequently occurring in the northern parts of the country.

¹ <http://www.research4cap.org/SitePages/Climate%20Adaptation.aspx>

Other points noted:

- Emphasis for Phase 2 is on action with a need to focus on implementation, starting immediately;
- ReCAP: focus will be on uptake, embedment of norms and standards and capacity building;
- ANE should use the Workshop as an opportunity to put forth their aspirations for Phase 2, engage with the project team and to take ownership of the work being done;
- Inter-regional (Africa-Asia) dialogue on climate adaptation is now becoming important.

5.1.2 Climate threats analysis

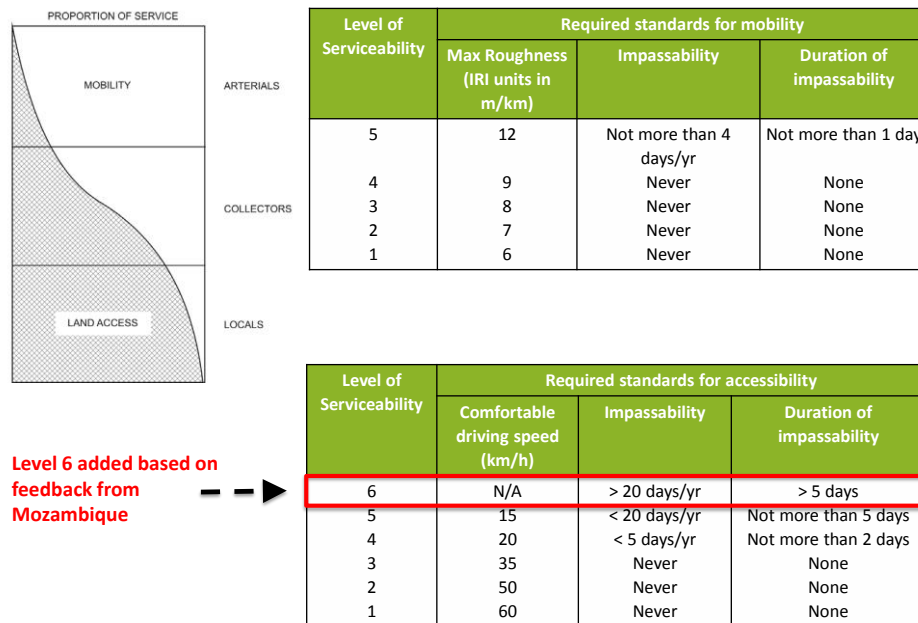
- The districts from southern Mozambique (Gaza and Inhambane provinces) northwards to central Mozambique emerge as being vulnerable in terms of observed climate related impacts;
- However, based on current and projected data, the northern regions of Mozambique are becoming increasingly more vulnerable (e.g. Nampula and Zambesi) – they should be included in the study, possibly also including a demonstration site.

5.1.3 Climate-related rural road vulnerability assessment: Methodological development and application

- Vulnerability assessments have been carried out based on specific assumptions
 - Acknowledged by ANE as an important tool for planning;
 - Need to understand the differences between the World Bank and the Project Team’s approaches to vulnerability assessments in Phase 2.
- Land-use practices are particularly relevant – how should these be managed better?
- Need to implement early warning systems, especially for rural communities;
- Rural accessibility: current study based on 5km from any road. A new approach, based on some form of criteria around 2km from an ‘all-weather’ access road will be needed.

5.1.4 A methodology for adaptation of low volume access roads to climate impacts

- Need to build greater robustness/resilient of structures, but funding/budgets is an issue;
- How to deal with impacts caused by issues outside the responsibility of ANE (e.g. deforestation)?
 - Institutional cooperation will be needed to balance preparations for climate change effects across the various sectors;
 - National Climate Adaptation Committee will be a useful future forum to coordinate activities related to climate change across the various stakeholders – the road/transportation sector should be represented.
- Definition of appropriate Levels of Service to mobility and accessibility for Mozambique were discussed and the following provisional table was produced for further discussion at all Workshops:



Further discussion on the above took place at subsequent workshops held in Ghana and Ethiopia.

- The 11EDF EU Rural Development Fund will address a need to incorporate a Climate Adaption Methodology into their *identification* and *procurement* activities. Outline design is expected by March. Two areas are covered, Zambesi/Nampula and climate adaptation interventions are to be taken into account. A financing agreement should be in place by end 2017. EU are looking for assistance to deliver a climate adaptation study leading to inclusion within the TOR for design and construction. Tender is expected mid-2018.

5.1.5 Engineering adaptation options

- Summary of main discussion points:

 - Dedicated training required on rendering road infrastructure more climate resilient;
 - Greater acknowledgement of climate effects in standards and guidelines (embedment) required;
 - Need for a better understanding on storm return periods as input for design;
 - Water harvesting (road ponds) to be considered;
 - There are substantial funding constraints – budget for maintenance is 60% less than required, with backlogs dating as far back as 10 years in some areas (e.g. in Nampula). These budget restrictions mean that only routine maintenance and spot improvements are done (no capital works), with most funds directed to priority routes (i.e. main roads rather than rural access roads) – current focus: “maintain what we have”;
 - **Do nothing** or **do minimal** an important option at this stage;
 - The implementation of Phase 2 may provide a useful basis for advocating for more funding;

- Need for dialogue between Development Partners (e.g. DFID, EU, World Bank, etc);
- Subsequent to the meeting, Malte Engelien (EU Programme Officer Infrastructure) has requested the Project Team to visit the Nametil-Angoche Road in Nampula to assist in preparation of a design guide which can be appended to the TORs for the design consultant.

5.1.6 Non-engineering adaptation options

- Issues raised during discussion:
 - Capacity building identified as a key need;
 - Ways to access funding for maintenance and emergency repairs to restore access/mobility was noted as a priority;
 - Lack of contingency plans – if the north-south corridor is impacted by flooding and damage to infrastructure, the economy comes to a halt;
 - Modify policies and plans – Road Asset Management Systems (RAMS) was recognised as a useful system that should be extended to cover climate adaptation indicators and to prioritise needs accordingly;
 - Embedment of climate resilience in norms and standards – identified as a potential “quick win”;
 - Assistance to be provided by AfCAP to raise importance of roads/transport in the National Climate Adaptation Committee;
 - Other areas of potential assistance by AfCAP:
 - Alignment, master planning and land use planning;
 - Improved network and programme management to anticipate and mitigate impacts;
 - Environmental management;
- Technical assistance support and assisted implementation support to be provided by AfCAP to:
 - Newly established Directorate of Emergencies (ANE-GE)
 - DIPLA, DIPRO, DIMAN
 - National Climate Adaptation Committee

5.1.7 Discussions on selected demonstration sites

- Road selected for demonstration section is road R448 from Chokwe to Macarretane;
- Selected road (R448) has been classified ‘vulnerable’ based on the World Bank Screening Tool (evaluates climate impact risk by specific road types). World Bank requires ANE to screen all roads targeted for rehabilitated by using this Screening Tool and to prioritise accordingly – Phase 2 to explore the wider applicability of this tool;
- Importance of not building embankment in low-lying, flood-prone areas was noted;
- The contract for road R448 has gone out as a Design & Build:
 - Concept designs completed, contract has been awarded
 - Urgent interactions with ANE, World Bank and contractor required
 - Strive for a variation order
- Need was identified for AfCAP to interact with the 11th European Development Fund (11 EDF) Programme (EU funded) to explore opportunities for collaboration.

5.1.8 Recommendations for Phase 2

- Priority areas to be covered comprise Demonstrations, Data, and Capacity Building.
- Need to provide assistance to ANE to allow them to engage more effectively with World Bank/Nordic Development Fund (NDF)/JICA/EU/DANIDA with evidence to support their funding applications.
- Demonstration sections:
 - Project team to assist in the justification/motivations to World Bank and EU
 - Opportunities for collaboration with EU (11 EDF) in Nampula and Zambesi Provinces (rural access roads: focus on climate resilience) – demonstration projects to be followed up.
 - R448: Chokwe to Macarretane
 - Contractor to complete detail designs by May 2017; establishment on site: March 2017;
 - Engagements with ANE, World Bank and contractor in February 2017 (variation orders probably required);
 - Detailed site investigation and designs for demonstration sections to be completed by April 2017;
 - Dialogue with Development Partners on funding requirements/arrangements requested;
 - Need to update or augment Standards to embrace Climate adaptation.
- Focus on data/information requirements of ANE:
 - Vulnerability assessment methodology and data to supplement ANE’s GIS-based RAMS;
 - Training of condition assessors will be required: simple augmentation of existing forms and training on climate vulnerability required;
 - Compatible with existing systems. Additional climate vulnerability data needs to be embedded in RAMS – it is important that there is compatibility with existing systems;
 - Data/information informs priorities and decisions, which inform strategy and eventually policy.
- Capacity Building should include:
 - Training at several levels and across all important stakeholders;
 - Some training should be in Portuguese and carried out at the demonstration sites;
 - Consideration should be given to producing reports and materials in Portuguese;
 - Emphasis should be on uptake and embedment;
 - Assisted implementation of Adaptation Methodology requested.

5.2 Ghana

5.2.1 Introductions

The Workshop was opened by Mr G.J. Brocke, Chief Director, Ministry of Roads and Highways. He noted the urgency to translate ‘talk’ into ‘action’, focussing on practical implementation of climate adaptation measures on roads, starting immediately.

Other points noted:

- Need for greater exchange of ideas between regions (Asia and Africa);
- Greater focus on uptake and embedment in norms and standards, with capacity building being integral to the process.

5.2.2 Climate threats analysis

- Flooding in the north of Ghana confirmed to be very problematic;
- Accuracy of the historical climate data was questionable and the recommendation was to correlate climate data (e.g. flood data) with those of MESTI;
- The meteorological office recently completed an exercise on derivation of design rainfall for the whole country. From the project's perspective, it will be useful to get more information on this;
- Flood problems not limited to rural areas; also prevalent in urban areas – need for solutions (curbs, drains, etc);
- How to deal with land-use practices particularly important;
- Need information on other climate parameters (e.g. wind, sea level heights);
- Need for more detailed climate data (i.e. reliable baseline data, especially at project level, inclusive of a revision of storm return periods).

5.2.3 Climate-related rural road vulnerability assessment: Methodological development and application

- Rural accessibility: Phase 1 used 5km radius for accessibility. Phase 2 will address 2km from either an access road or from an all-weather access road (to be decided);
- Can the vulnerability assessment methodology be used for other types of assets (e.g. powerlines or rail)? – The answer was affirmative, but additional (asset-related) input parameters will be required;
- Need for probabilistic risk analyses to support project-level design decisions (i.e. identification/quantification of climate threats for individual road sections);
- Need to entrench vulnerability assessment (and all associated data) in RAMS to support decision making.

5.2.4 A methodology for adaptation of low volume access roads to climate impacts

- Asian Development Bank's (ADB) adaptation methodology designed for national roads – may require some adjustment for low-volume access roads;
- *Handbook* required on climate threat risk assessment and prioritisation;
- Explore the development and implementation of a sustainability rating system;
- At a policy level, a multi-sectoral assessment of climate threats is warranted. For example, floods are a nuisance for roads, but harvesting rain water from the road reserve can be beneficial (i.e. road ponds);
- Definition of appropriate Levels of Service to mobility and accessibility for Ghana were discussed. No additional inputs on the Levels of Service proposed in Mozambique were offered (cf. Section 5.1.4);
- "Demonstrators" do not have to be physical, asset-related demonstrators. Step-by-step demonstrations on how to implement the adaptation methodology on real life case studies should also be considered. The same applies to the embedment of climate adaptation in RAMS.

5.2.5 Engineering adaptation options

- Comprehensive feedback during discussions:
 - Dedicated training required on rendering road infrastructure more climate resilient;
 - Greater acknowledgement of climate effects for standards and guidelines (embedment) required;

- Keywords are water (drainage within and outside the road reserve), compaction (incl. construction quality) and maintenance;
- Areas of cut to fill cross-sections are high risk areas, particularly in areas of high rainfall. Down-slope failures are the costliest to repair;
- Potential for water harvesting (road ponds) to be investigated;
- Noted that 1:100-year storm is expected to return every 18 years (based on a study by COWI). Need for a better understanding on storm return periods. Require reliable baseline climate data;
- Changes in land cover have an impact on water run-off and therefore on drainage systems. Land use may also change after a road is constructed;
- Start applying adaptation options now in order to save on future costs;
- Do nothing or do minimal is an important option, but “do-nothing” does not equate to maintaining the status quo. A back-strengthening maintenance approach could become cost-effective – it will eventually reduce maintenance costs. Should start implementing this now in order to save on future costs.

5.2.6 Non-engineering adaptation options

- It was noted that, although budgets from Road fund had improved, funding shortages are acute. There is a significant maintenance backlog. Despite the additional funding, only about 60 to 70 per cent of the network will be covered in two to three years’ time;
- Emergency funds only approximately 4 to 5 per cent of budget – they are not considered to be sufficient;
- The implementation of Phase 2 may provide a useful basis for advocating for more funding;
- Importance of *Monitoring & Evaluation* to build on lessons learned and inform changes in (e.g.) norms and standards;
- National Climate Adaptation Committee to be reconstituted. Importance of representation of the roads sector on the Committee was noted. National Climate Change Plan 2010-2020 is currently under revision, and the next Medium-Term Plan will be submitted this year because (i.e. 2014-2017 Plan comes to an end). ReCAP/AfCAP can advise on the inclusion of climate adaptation aspects for low-volume road resilience;
- Embedment of climate adaptation in all practices and processes urgently required;
- Training of all (young) engineers across the sector, including district engineers and consultants (e.g. through an ongoing course at KTC, Kofovidua Training Centre) – urgent need for handbook and training packages. The Ghana Institute of Engineers can also be used as a means to ensure that all engineers registered with the institute receive training on climate adaption aspects;
- Audits of design should be done to ensure that climate adaptation measures are sufficiently embedded in the designs;
- Must have political will; must have buy-in of all stakeholders, from central government to village groups
 - Half-day briefing session at key strategic level recommended
 - ReCAP/AfCAP can assist
- Next Medium-Term (4-year) Plan to be submitted this year:
 - Climate adaptation to be incorporated
 - ReCAP/AfCAP can advise
- National Transport Policy to be reviewed
 - ReCAP/AfCAP can advise

5.2.7 Discussions on selected demonstration sites

- Technical issues noted or discussed:
 - Cannot realign waterways;
 - Scour checks (check dams) to be recommended to reduce water velocity and therefore risk for erosion;
 - Harvesting of water in wet season for construction in dry season required (i.e. alternative use of “road ponds”);
 - Use of impact roller to reduce water demand during construction advised;
 - Mechanical stabilization (blending of materials) for embankments advised – gravel materials of low plasticity could be susceptible to erosion/wash-out;
 - Use of (vegetated) rip-rap on embankments;
 - Stage construction in line with changes in climate to be considered:
 - Decide on return period
 - Identify worst case scenario;
 - Stage implementation accordingly with due recognition of available budget;
 - Erosion on steep slopes: requires the implementation of adaptation options (synergy with AfCAP project conducted in Ghana on “Steep Slopes”).
- Broader issues
 - Need to broaden assessment from “road” to “corridor”, with specific focus on climate resilience
 - Demonstration sections to be framed within the 20-step adaptation methodology (and review/adjust methodology);
 - Road condition and inventory field forms to be developed, demonstrated (training) and implemented;
 - Interrogate maintenance and rehabilitation manuals with respect to climate resilience.

5.2.8 Recommendations for Phase 2

- Demonstration sections:
 - Need discussions between Ministry, DFR and AfCAP Project Team on scope and timeline – construction most likely to start in October (end of rainy season);
 - Need back-working of adaptation threats, risks and methodology;
 - Handbook (incl. training tools) requested. To be used as a basis for:
 - Training of (district) engineers at KTC;
 - Training of consulting engineers by Ghana Institute of Engineers;
 - Review of maintenance and rehabilitation manuals from the perspective of climate adaptation;
 - Maintenance Wizard to be restarted
- Advice and institutional support:
 - Briefing session at key strategic level;
 - Fliers for communities and stakeholders;
 - Mainstreaming climate change in policies and plans (e.g. National Transport Policy);
 - National Adaptation Plans to be reviewed (specific plans for road sector required);
 - Medium-Term (4-year) Plan to be submitted in 2017;
 - Recommendations for augmentation of design standards and specifications;

- Dialogue with Development Partners on funding requirements/arrangements requested;
- Advice on project applications to Green Climate Fund and for current proposal to Nordic Development Fund.
- Capacity Building should include:
 - Training at several levels and across all important stakeholders;
 - Emphasis should be on uptake and embedment;
 - Assisted implementation of Adaptation Methodology requested.

5.3 Ethiopia

5.3.1 Introduction

The workshop was opened by Ato Mohammed Abdurahman, Deputy Director General of the Ethiopian Roads Authority. He noted the importance of this programme in view of the fact that climate change is already causing substantial problems on the roads within the country. Hence immediate action to minimise the impact of climate change on low-volume access roads should be a priority.

Other points noted:

- ReCAP: focus on uptake, embedment in norms and standards and capacity building;
- Development Partners have similar aims and objectives – there is need for greater synergy through cooperation and collaboration.

5.3.2 Climate threats analysis

- The climate threats analysis has been based on climate projections for a low-mitigation scenario;
- Substantial resources will be required to maintain accessibility. ERA's capacity is limited and therefore prioritisation and adoption of a phased approach are key;
- Different geographical areas in Ethiopia will be impacted differently by climate effects. There is a need to ensure that all needs/problems are identified and addressed.

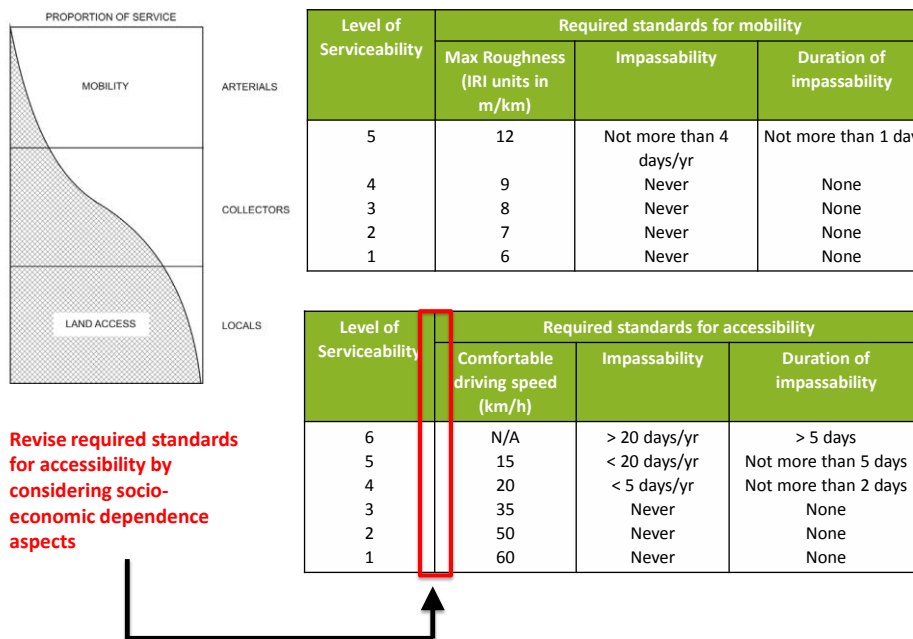
5.3.3 Climate-related rural road vulnerability assessment: Methodological development and application

- Definitions and methodology should not be limited to low-volume access roads. They should be applicable to all roads, and practitioners should be trained accordingly;
- Basic principles and approaches are applicable to all roads, but the cost for implementation would be higher for higher-volume roads;
- There is a need to look at broader aspects beyond infrastructure including transport operations, among others, but the focus must be mobility and access;
- There is a need to entrench vulnerability assessment and all associated data in RAMS to support decision making;
- To ensure that the results of the vulnerability assessments are reliable, good quality data would be needed as inputs;
- Considerations on how to implement vulnerability assessment methodology in Ethiopia include:
 - Creating capacity through demonstration;
 - World Bank interested in a vulnerability assessment at National level;

- Request to consider extending the methodology to take into account World Bank needs under their capacity building components;
- Important to optimise, not duplicate efforts, hence cooperation between AfCAP and World Bank is needed.

5.3.4 A methodology for adaptation of low volume access roads to climate impacts

- World Bank interested in AfCAP establishing contact with Mr Shormick who is responsible for the Climate Change Agenda for the World Bank in Washington. Also, suggested to make contact with Simon Ellis. Ato Haileyesus Adamtel suggested that the World Bank could be interested in applying this methodology across their projects;
- Road asset management:
 - Road network inventory and asset condition database (GIS-based) is fully established;
 - ERA is in discussion with local/regional road authorities to regularly update condition data (every 2 years);
 - Emergency Works Unit has been established under the Road Network Coordination Directorate of the Asset Management Department.
- There is a need for embedment of climate adaptation into RAMS;
- Discussion around the proposed Serviceability Levels concluded that they could be applied in Ethiopia, provided the level were defined with respect to socio-economic considerations, see below:



Socioeconomic dependence suggested as an additional consideration for the different levels in the required standards for accessibility (Ethiopia)

5.3.5 Engineering adaptation options

- The adaptation options proposed were supported;
- There is concern about roads that have been built recently without consideration of climate threats, which could result in damage very early on in the lifetime of those roads;
- Dedicated training is required to embed climate adaptation considerations in road design and construction practice;
- Recurring themes in terms of engineering options include:
 - **Water** – Good drainage is essential to protect the road from damage and the surrounding land which interfaces with the road and associated structures;
 - **Compaction** must be done well and the choice of road materials is critical;
 - **Maintenance** is essential for the longevity of the road.
- Engineering adaptation is mostly based on application of “good engineering”, but implementation is key;
- Quality control:
 - Was expressed as a concern;
 - It should be managed against quality plan;
 - Process changes may be required (e.g. independent audits).
- A number of technical issues were raised:
 - Impact of changes in land cover on water run-off and therefore on drainage systems was noted;
 - Storm return periods are a critical input for design:
 - May require more regular updating in line with changes in the climate;
 - Benefits of climate change may accrue from areas experiencing drier climate.
 - High risk area: cuts and fills – repair of downslope failures can be very costly;
 - Slope stability:
 - Slope management system required – in process of being established in Ethiopia;
 - Guidelines/manuals have been published and are available;
 - Specialist geotechnical engineering inputs would be required for high-risk areas;
 - Vulnerable areas should be identified before design is undertaken.

5.3.6 Non-engineering adaptation options

- National Climate Adaptation Committee – there is uncertainty as to whether the roads sector is represented so further investigation will be undertaken;
- There are several national climate adaptation plans of action published in the last five years, but transport infrastructure is not explicitly addressed in these;
- Economics to Climate Adaptation (World Bank study) highlights the need for building greater climate resilience in transport infrastructure;
- World Bank has established a Regional Innovation Centre – one of its six pillars is Transport. It is understood that this Centre is not particularly active (to be investigated);
- 5th Road Sector Development Program (RSDP) – need to interrogate to what extent climate adaptation is addressed.

5.3.7 Discussions on selected demonstration sites

- Several technical issues were raised/discussed:
 - Cannot realign waterways;
 - Implementation of check dams to reduce water velocity (erosion) – they may require regular maintenance because of sedimentation;
 - Ensure that most climate-related issues impacting on low-volume roads are catered for (potential additional demonstrations in Phase 2?);
 - To render earth roads climate resilient, they need to be upgraded to at least engineered earth roads;
 - Prioritisation is a function of service levels to be achieved/met.

- Broader issues:
 - Climate (change) currently not sufficiently embedded in existing national design practices – some recently constructed roads did not survive one rain season;
 - Proper construction supervision is often lacking;
 - Embedment of climate adaptation in design approach and in guidelines needed;
 - Complementary activities:
 - Environmental Impact Assessment (EIA): assesses the impact of roads on the environment (among others)
 - Climate vulnerability assessment: assesses the impact of the environment on roads (infrastructure assets & transport services)

5.3.8 Recommendations for Phase 2

- Demonstration sections & capacity building:
 - Need discussions between ERA and AfCAP Project Team on scope and timeline for demonstrators (aim for two regions with construction taking place after the rains – October 2017);
 - Need to build additional capacity at the Research Centre;
 - Training courses will be predominantly hands-on training, progressing towards train-the-trainer programmes;
 - Embedment of climate adaptation in current guidelines could include:
 - Handbook (incl. training tools);
 - Part H to LVR design guideline (for inclusion in next revision, probably in five years' time).
 - Monitoring and evaluation plan to be put in place.
- Advice and institutional support:
 - Synergies noted with other Development Partners – need to build on those;
 - Briefing session requested at key strategic level;
 - Full capacity building programme requested to start early;
 - Multi-sector involvement needed;
 - Alignment with existing policies and strategies to be fully explored;
 - Mainstreaming of climate adaptation in policies and strategies requested.

6. Workshop recommendations

Based on the feedback obtained at the workshops held in Mozambique, Ghana and Ethiopia, there appears to be a general lack of awareness on the effects of climate on road infrastructure, and the consequential impacts thereof on not only rural accessibility, but also on the cost of maintaining and reinstating access, especially after the occurrence of severe climate events. In Phase 2 of the Climate Adaptation programme, more effort will have to be invested in creating greater awareness, from the level of key stakeholders (decision-makers) to that of district engineers.

Creating awareness is, however, not sufficient. What the road authorities are after are also (and especially) cost-effective, implementable solutions for:

- a) Better understanding the vulnerabilities within their road network, and the socio-economic consequences on rural communities in the event that accessibility is curtailed as a result of weather events;
- b) Prioritising the limited funding at their disposal, both pro-actively and reactively;
- c) Implementation (almost immediately) of simple, affordable and effective engineering options in order to better protect current infrastructure (e.g. through back-strengthening maintenance, or built into rehabilitation/new designs);
- d) Greater embedment of the notion of 'climate adaptation' in policies and strategic plans, cascaded down to its embedment in norms, standards, manuals and guidelines, and hence then also the integration of climate adaptation in all aspects of road engineering (i.e. planning, design, construction and maintenance).

Building of local capacity will be key to achieve the above. A significant number of the workshop participants expressed the need for guidance, coaching and hands-on training. This could be achieved through several means, which could include:

- a) Demonstration of engineering adaptation on site: at least one demonstration section will be established in each one of the three countries. This creates the opportunity for local practitioners to become involved in site investigations, the identification of appropriate adaptation options (and the reasoning behind those), the design phase, the construction phase (with due attention devoted to quality of construction), and subsequent monitoring and evaluation;
- b) 'Soft' demonstrators to guide practitioners through the processes of, for instance:
 - a. identifying vulnerable districts and road links within those, using the vulnerability assessment framework developed in Phase 1 of the programme (with the necessary customisation), and capacitate them to apply this methodology on a wider scale; and
 - b. embedding 'climate adaptation' in road asset management systems so as to support prioritisation and decision-making based on a broader spectrum of attributes, in addition to present road conditions. This will also require road condition assessors to be trained to identify potential environment-related risks and threats within and outside the immediate road environment.
- c) Development of a dedicated handbook and associated training material on all aspect related to "risk management and resilience optimisation for vulnerable road access", which could be used as a basis for the training of public and private sector practitioners in how to address climate variability and change, and the implementation of a train-the-trainer programme.

The above summarises the primary needs and recommendations expressed by the Workshop participants. The individual Workshop Reports contain additional specific items. These will be further

analysed by the AfCAP Project Team and will inform the programming of activities to be carried out in Phase 2 of the Climate Adaptation programme.

7. Attendance and Feedback from Workshop participants

7.1 Mozambique

Of the 16 participants who attended the Workshop, 14 evaluation forms were returned. The evaluation form that was used (cf. Annex B) was based on a standard evaluation form prepared by ReCAP Management.

A summary of the ratings for the Mozambican Workshop, together with the list of participants who attended the Workshop, are provided in Annex C.

The overall rating was **B: good and useful** (average score 4.0 out of 5.0). Exceptions to this was Question 4 (Were you as participant able to effectively contribute to the different sessions of the workshop?), which was given a **C: OK** (3.4). It is understood that this was predominantly because of language difficulties of understanding English and the specialised terminology.

Key items for improvement cited were presentations in Portuguese and pre-circulation of material. The participants look forward to hands-on training on site for Phase 2.

Overall, the main aspects the participants learned from the Workshop and found useful were:

- Awareness of the impacts of climate change;
- Measures to build resilience (e.g. adoption of climate adaptation options in design);
- Need for greater preparedness to address climate effects;
- Importance of non-engineering adaptation options, including policies, strategies and plans;
- Need for proper coordination across government institutions – multi-disciplinary approach;
- Need to develop in-country capacity;
- Implementation of vulnerability assessment and adaptation methodologies.

7.2 Ghana

Of the 34 participants who attended the Workshop (cf. Annex D), 21 evaluation forms were returned.

The overall rating was **B: good and useful** (average score 4.2 out of 5.0). Similar to Mozambique, the participants' level of contribution to the workshop was rated the lowest (3.5). The participants called for more hands-on training and break-away sessions, and recommended that future workshops or training programmes should involve field trips and field work. The participants enjoyed the presentations and the discussions, and there was a good appreciation of the need for applying adaptation methodologies.

Overall, the main aspects the participants learned from the Workshop and found useful were:

- Awareness of the impacts of climate change;
- Engineering and non-engineering adaptation options to identify/manage risk, to drive policy and strategies, and to yield sustainable solutions;
- Importance to integrate climate adaptation in all aspects of road engineering: planning, design, construction and maintenance;
- Urgent need for more climate resilient designs;
- Realisation that most adaptation solutions are based on 'sound engineering' and that there are simple and cost-effective engineering methods for adapting rural access roads so as to become more climate resilient;
- Road asset vulnerability assessment and adaptation methodologies.

7.3 Ethiopia

Of the 24 participants who attended the Workshop (cf. Annex E), 16 evaluation forms were returned.

The overall rating was **B: good and useful** (average score 4.3 out of 5.0). Again, as was the case in Mozambique and Ghana, the participants' level of contribution was rated the lowest (3.6). They believed that there should have been greater involvement of other sectorial stakeholders, which to some extent could have been attributed to the location of the workshop. Again, the participants would have preferred to receive reading material prior to the workshop. Some were also of the opinion that the workshop was too short in view of the scope and importance of the issues tabled.

Overall, the main aspects the participants learned from the Workshop and found useful were:

- Engineering and non-engineering adaptation options to drive sustainable solutions, and to boost adaptive capacity, particularly focussing on rural access;
- Importance to integrate climate adaptation in all aspects of road engineering: planning, design, construction and maintenance;
- Importance of climate data/projections and adaptation strategies to ensure sustainable access;
- That adaptive capacity will improve by the review of existing policies, engineering practices and manuals;
- Climate adaptation methodologies and action plans (e.g. 20 steps);
- Measures to build resilience (e.g. adoption of climate adaptation options in design);
- Capacity building and dissemination of knowledge, also involving multi-sector participation;
- Demonstrators (trial sections) being very important hands-on learning events.

Annex A: Generic Workshop Programme

Time	Activity / Topic	Presenter	Facilitators
Day 1			
08:00 - 08:30	Arrival and Registration	Secretariat	Dr J Cook / N Leta / L Sampson / B Verhaeghe
08:30 - 08:45	Welcome and Introductions	Government Official	
08:45 - 09:00	Overview of ReCAP/AfCAP <ul style="list-style-type: none"> • Purpose, objectives and programme • Progress to date • Outputs and aspirations for outcomes 	L Sampson / Dr J Cook	
09:00 - 09:30	Overview of Climate Adaptation programme objectives, deliverables and plans	B Verhaeghe	
09:30 - 10:30	Climate Change effects <ul style="list-style-type: none"> • Observed climate impacts on Africa / AfCAP Partner countries • Projected climate change • Specifics for host country • Impact of climate on road elements 	S Makhanya	
10:30 - 11:00	<i>TEA BREAK</i>		
11:00 - 12:00	Overview of Adaptation Methodology <ul style="list-style-type: none"> • Screening and scoping • Vulnerability and risk assessment methodology • Implementation (case study) • Adaptation methodology 	S Makhanya / M Head	As above
12:00 - 12:30	Discussion on technical approach	M Head	
12:30 - 13:30	<i>LUNCH BREAK</i>		
13:30 -14:30	Generic Engineering Adaptation Options <ul style="list-style-type: none"> • Increasing resilience • Drainage • Maintenance 	Dr P Paige-Green	As above
14:30 - 15:30	Discussion on Engineering Options and budget implications	Dr P Paige-Green / M Head	
15:30 - 16:00	<i>TEA BREAK</i>		
16:00 - 17:00	Non-Engineering Adaptation Options Overview & Discussion	M Head	As above

DAY 2			
08:30 - 09:30	Demonstration Sites Feedback <ul style="list-style-type: none"> • Overview of roads visited and observations • Selected road and recommendations for adaptation 	Dr P Paige-Green	As above
09:30 - 10:30	Discussion on process, recommendations and implementation	Dr P Paige-Green	
10:30 - 11:00	<i>TEA BREAK</i>		
11:00 - 12:00	Introduction to Recommendations for Phase 2 <ul style="list-style-type: none"> • Overall aim • Objectives • Scope of works • Deliverables 	M Head	As above
12:00 - 12:30	Discussion	M Head / B Verhaeghe	
12:30 - 13:30	<i>LUNCH BREAK</i>		
13:30 - 15:30	Facilitated discussion on Recommendations for Phase 2 <ul style="list-style-type: none"> • Implementation and monitoring of demonstrations sections • Capacity building, knowledge exchange and training • National policies, strategies and plans • Uptake and embedment of outcomes 	M Head / B Verhaeghe	As above
15:30 - 16:00	<i>TEA BREAK</i>		
16:00 - 17:00	Workshop summary, closing remarks and Vote of Thanks	B Verhaeghe / ReCAP / Government Official	

Annex B: Workshop Evaluation Form



AfCAP Climate Adaptation Workshop

EVALUATION FORM

Please fill in this form so we can learn from your experience and opinion. The feedback you provide will remain anonymous

GENERAL QUESTIONS

1. Please list three things that you have learned during this workshop.
 - a)
 - b)
 - c)

Please evaluate the programme elements, by circling one of the letters A to E or Z.

A= Very useful, very good; B= useful, good; C= OK; D= rather weak; E= very poor
Z= absent – Other additional written comments welcome !!

2. How would you rate the overall usefulness of this workshop? ☺- A – B – C – D – E - ☹ Z
3. To what extent did the workshop meet your expectations? ☺- A – B – C – D – E - ☹ Z
4. Were you as participant able to effectively contribute to the different sessions of the workshop? ☺- A – B – C – D – E - ☹ Z
5. How do you rate the workshop schedule/timetable? ☺- A – B – C – D – E - ☹ Z
6. What was your impression of the logistical organisation and management of the workshop? ☺- A – B – C – D – E - ☹ Z
7. How would you rate the presentations on climate effects and climate adaptation methodologies (Day 1)? ☺- A – B – C – D – E - ☹ Z
8. How would you rate the presentations on engineering and non-engineering adaptation options (Day 1)? ☺- A – B – C – D – E - ☹ Z
9. How would you rate the presentation on Demonstration Sites Feedback (Day 2)? ☺- A – B – C – D – E - ☹ Z
10. How do you rate the presentation and discussion on the recommendations for Phase 2 (Day 2)? ☺- A – B – C – D – E - ☹ Z

Thank you for your comments and suggestions!



11. What are the two and most useful aspects of the workshop?

12. How could the workshop have been improved?

13. Do you have any other comments or suggestions?

Thank you for your comments and suggestions!

Annex C: Workshop Evaluation Scores and Attendance Register - Mozambique

Climate Adaptation: Workshops held in Mozambique, Ghana and Ethiopia

No	Questions	Rating score	Number of responses					Average of scores
			A=5	B=4	C=3	D=2	E=1	
2	How would you rate the overall usefulness of this workshop?	2	9	3			3.9	
3	To what extent did the workshop meet your expectations?	4	6	4			4.0	
4	Were you as participant able to effectively contribute to the different sessions of the workshop?	2	4	6	1	1	3.4	
5	How do you rate the workshop schedule/timetable?	5	6	3			4.1	
6	What was your impression of the logistical organisation and management of the workshop?	6	8				4.4	
7	How would you rate the presentations on climate effects and climate adaptation methodologies (Day 1)?	5	7	2			4.2	
8	How would you rate the presentations on engineering and non-engineering adaptation options (Day 1)?	4	8	2			4.1	
9	How would you rate the presentation on Demonstration Sites Feedback (Day 2)?	2	9	2			4.0	
10	How do you rate the presentation and discussion on the recommendations for Phase 2 (Day 2)?	4	7	2			4.2	
AVERAGE OF ALL SCORES:							4.0	
1	Three things learned during the Workshop:							
	Awareness about climate change - variability and trends (x7)							
	Issues to be considered in design viz-a-viz climate change impacts (x7)							
	Need for greater preparedness to address climate effects (x4)							
	Importance of non-engineering adaptation options, including policies, strategies and plans (x3)							
	Need for proper coordination in planning/execution across government institutions - multi-disciplinary nature of climate adaptation (x2)							
	Climate adaptation options for rural access roads (x2)							
	Vulnerability and risk assessment, and mapping thereof							
	Regional vulnerability to climate change							
	Impact of climate change on road strategy development							
	Need for incorporating climate change in specifications							
	Recommended adaptations should be done, recognising that different options will have to be applied in different regions/countries							
	More climate-resilient designs can save money in the long term							
	Quantification and prioritisation of risks							
	80% of population live in rural areas							
11	Two and most useful aspects of Workshop:							
	Solutions to be considered for climate resilience of road infrastructure (x8)							
	Awareness about climate change effects and impacts (x4)							
	Need to develop in-country capacity and disseminate knowledge (x2)							
	Vulnerability and risk assessment methodology (x2)							
	Implementation of recommendations is key							
	Need for practical demonstrations							
	Proposed actions for demonstration sections							
	There is a buy-in of the project at all levels - all Mozambican authorities should be involved							
	Research and knowledge sharing							
	Recommendations for Phase 2, including solutions for demonstrators							
	Budget implications							
	Quality communication and feedback by the project team							
12	How could the Workshop have been improved?							
	Some participants may not have been actively involved because of language barrier. Presentations in Portuguese are advisable (x4)							
	Participants to have time to read the material before the workshop (x3)							
	Because of language hurdle, more figures or examples and less text (x2)							
	Hands-on training on site (x2)							
	Other sectors/stakeholders should have been invited to the workshop (x2)							
	Need more demonstrators in other geographical regions							
	Duration of presentations: could be shorter							
	More time spent on climate context							
13	Any other comments or suggestions							
	Include in the team someone with good knowledge of the Portuguese language (x2)							
	Strengthen coordination across institutions, including development partners (x2)							
	Phase 2 needs a greater focus on quality of design and construction - this is a problem in Mozambique							
	Next phase should focus more on hands-on training							
	Excellent sharing of knowledge							
	NB! This project should be linked to the 200km rehabilitation project in Gaza							
	Need to review all road construction material guidelines, structural guidelines and hydraulics manuals (inclusive of return periods)							

Climate Adaptation Workshop held in the ANE Conference Room in Maputo, Mozambique on 30 and 31 January 2017

Attendance Register

Name	Position	Organisation	Day 1	Day 2
Irene Simões	Director	ANE - DIMAN	X	X
Luís Fernandes	Director	ANE - GE	X	X
José Filipe Bento	TA - ANE	ANE	X	X
Atanásio Mugunhe	Eng. Civil / Transp.	ANE	X	X
D. Patel dos Santos	Eng. Civil / Transp.	ANE	X	X
Emília Tembe	Head of Monitoring Dept.	ANE	X	
Rubina Normahomed	Eng Civil	ANE	X	
Décio Roia	Tec. Ambiente	ANE - DIPRO	X	X
Inácio Sitoi	Technico	ANE		X
Hilário Tayob	Technico	ANE	X	X
Raquel Langa	Technico	ANE - DIPRO	X	X
Rogério F Simione	Technico LAB	ANE - NPI	X	X
Moises Alexandre Dzimba	Technico	ANE - GAZA	X	X
Carlos Cumbane	Technico	LEM	X	X
Santos Aurilio Cuinica	Eng. Civil/Transp.	LEM	X	X
Isaias Raiva	Pesquisa	INAM	X	X
Michela Vat	Consultant	Consultec	X	
Les Sampson	Infrastructure Research Manager	ReCAP	X	X

Name	Position	Organisation	Day 1	Day 2
Nkululeko Leta	Regional Manager	AFCAP	X	X
Philip Paige-Green	AfCAP Consultant	PGC	X	X
Benoit Verhaeghe	AfCAP Consultant	CSIR	X	X
Sibusisiwe Makhanya	AfCAP Consultant	CSIR	X	X
Mike Head	AfCAP Consultant	SHC	X	X

Annex D: Workshop Evaluation Scores and Attendance Register - Ghana

Climate Adaptation: Workshops held in Mozambique, Ghana and Ethiopia

No	Questions	Rating score	Number of responses					Average of scores
			A=5	B=4	C=3	D=2	E=1	
2	How would you rate the overall usefulness of this workshop?		16	5				4.8
3	To what extent did the workshop meet your expectations?		6	10	5			4.0
4	Were you as participant able to effectively contribute to the different sessions of the workshop?		3	7	8	3		3.5
5	How do you rate the workshop schedule/timetable?		10	8	3			4.3
6	What was your impression of the logistical organisation and management of the workshop?		4	12	5			4.0
7	How would you rate the presentations on climate effects and climate adaptation methodologies (Day 1)?		8	11	2			4.3
8	How would you rate the presentations on engineering and non-engineering adaptation options (Day 1)?		11	7	3			4.4
9	How would you rate the presentation on Demonstration Sites Feedback (Day 2)?		12.5	5.5	2			4.5
10	How do you rate the presentation and discussion on the recommendations for Phase 2 (Day 2)?		7	10	2			4.3
AVERAGE OF ALL SCORES:							4.2	
1	Three things learned during the Workshop:							
	Awareness about climate change - variability/trends, climate change effects and impacts (x11)							
	Engineering and non-engineering options to identify/manage risk, to drive policy and strategies and to yield sustainable solutions (x9)							
	Importance of climate adaptation in all aspects of road engineering: planning, design, construction, maintenance (x8)							
	Issues to be considered in design viz-a-viz climate change impacts - urgent need to implement climate resilient road designs (x5)							
	Most adaptation solutions are based on 'sound engineering' - proper implementation (good engineering/construction) is key (x4)							
	Climate resilient roads could cost more, but could have lower life-cycle cost (e.g. reduced future maintenance/rehabilitation costs) (x3)							
	Simple and cost-effective engineering methods of adapting roads to become more climate resilient (x3)							
	Vulnerability and risk assessment, and mapping thereof (x2)							
	Climate adaptation methodologies and actions plans (x2)							
	Research, knowledge sharing and capacity building; uptake and embedment of research findings (x2)							
	Climate change is a reality which must be factored into road asset management to minimise its impact (x2)							
	Importance of quality and reliable data as input in decision-making (x2)							
	Importance of monitoring and evaluation							
	Climate change impact progression is of serious concern and must be given the necessary attention							
	Use of cuts and fills, and the risk for downslope failures							
	Broader stakeholder involvement required to tackle the problem of climate change							
	Role of remote sensing and GIS technology in assessing road vulnerability							
11	Two and most useful aspects of Workshop:							
	Awareness about climate change - variability/trends, climate change effects, adaptation (x5)							
	Engineering and non-engineering adaptation options to boost adaptation capacity, particularly focussing on rural access (x4)							
	Road asset vulnerability assesment and adaptation methodologies (x3)							
	Engineering adaptation options for different types of roads/structures (x3)							
	Quality communication and feedback by the project team, as well as the discussions (x3)							
	Adoption of 'sound engineering' principles in adaption (incl. simple, low-cost measures) (x2)							
	Need for capacity building and knowledge dissemination (x2)							
	Demonstration site feedback (x2)							
	Demonstrations (trial sections) considered a very important hands-on learning event							
	Cautious use of appropriate construction materials							
	Ability to interact with institutions directly involved within the Ghanaian road system							
	Implementation of appropriate adaptation measures to ensure sustainable access							
12	How could the Workshop have been improved?							
	More hands-on training (e.g. on vulnerability assessments) (x6)							
	Field trip and/or field work to be included in future training programmes (x4)							
	Break-out sessions on specific issues to ensure more participation (x3)							
	Participants to have time to read the material before the workshop							
	Workshop could have been extended to a one-week event							
	Broader group of stakeholders could have been invited to the workshop							
	By making it a resident workshop, more time would have been available to discuss/debate issues							
	Larger conference room							
13	Any other comments or suggestions							
	Future workshops should be organised close to the demonstration site(s), especially when work is ongoing							
	Capacity building of institutions involved in identifying, implementing and monitoring interventions							
	Consult CERSGIS (University of Ghana) for spatial datasets that will be required for risk assessments in Ghana (www.cersgis.org)							
	Workshop should be extended to other countries to create awareness and plan accordingly							
	Workshop should also be organised for other heads of agencies (decision makers) who couldn't take part in this workshop							

Climate Adaptation Workshop held at the Engineering Centre of the Ghana Institution of Engineers in Accra, Ghana, on 2 and 3 February 2017

Attendance Register

Name	Position	Organisation	Day 1	Day 2
Godwin J. Brocke	Chief Director	MRH	X	
John O. Asiedu	Director RSIM	MRH	X	X
Edmund Offei-Annor	Director P&P	MRH	X	X
Dr. K.O. Ampadu	DDP	DFR	X	X
Don F. Kuubeterzie	Reg. Manager	DFR	X	X
Seth Osei Nketiah	Regional Manager	DFR	X	
Efua Akwetea-Mensah	Principal Eng.	DFR	X	X
K. T. Oppong-Boadi	EPA Director	EPA	X	X
Efua Effah	Principal Eng.	MRH		X
Kwasi Agyemang Boakye	Snr Engineer	MRH	X	X
Edmond Balika	Asst. Engineer	MRH	X	X
George Lutterodt	Tech Eng	MRH	X	
Janet Armah	S.P.S	MRH	X	X
Samuel Inkoom	S.T.O	MRH	X	X
Juliet Amponsah	Env. Engineer	DFR	X	X
Emmanuel Ameyaw	OM II	DFR	X	X
Abdul-Fatawu Hamidu	Asst. Engineer	DFR	X	X
Frank Amofa Agyemang	Asst. Engineer	DFR	X	
Richmond Ankrah	IT/GIS Admin	DFR	X	X

Name	Position	Organisation	Day 1	Day 2
Frederick K Addison	OM II	DFR	X	X
Rita Ohene Sarfoh	Chief Eng.	GHA	X	X
Olivia Soli	Principal Eng.	GHA	X	
Hilda Annan	Snr Environmental Officer	GHA	X	X
Isaac Kwofie	Snr Tech. Eng.	GHA	X	X
Fred Gyimah	Engineer	GHA	X	X
Ruth Osei-Asomani	Environmental Officer	DUR	X	X
Ferdinand Yali	Safeguards	DUR	X	X
Kingsley K Agyemang	A.A.O	DCS-Mofa	X	X
Brian Tsikpor	Snr. Planner	LGS	X	X
Baah Tettels	Engineer	Local Govt Service Secretariat	X	X
Dr. Emmanuel O. Bekoe	Snr Research Scientist	CSIR-WRI	X	X
Francois Afukaar	Chief Res. Scientist	BRRRI	X	X
James Damsere-Derry	Research Officer	BRRRI	X	X
Stella Ofori-Ampofo	Remote Sensing App. Specialist	CERGIS	X	X
Victor Guyir Mwireh	Remote Sensing Analyst	CERGIS	X	X
Jasper Cook	ReCAP Team Leader	ReCAP	X	X
Paulina Agyekum	Regional Manager	AfCAP	X	X
B Verhaeghe	AfCAP Consultant	CSIR	X	X

Name	Position	Organisation	Day 1	Day 2
Mike Head	AfCAP Consultant	SHC	X	X
Phil Paige-Green	AfCAP Consultant	PGC	X	X
Sibusisiwe Makhanya	AfCAP Consultant	CSIR	X	X

Annex E: Workshop Evaluation Scores and Attendance Register - Ethiopia

Climate Adaptation: Workshops held in Mozambique, Ghana and Ethiopia

No	Questions	Rating score	Number of responses					Average of scores
			A=5	B=4	C=3	D=2	E=1	
2	How would you rate the overall usefulness of this workshop?		12	4				4.8
3	To what extent did the workshop meet your expectations?		5	8	3			4.1
4	Were you as participant able to effectively contribute to the different sessions of the workshop?			9	4	1		3.6
5	How do you rate the workshop schedule/timetable?		8	5	2		1	4.2
6	What was your impression of the logistical organisation and management of the workshop?		7	5	2			4.4
7	How would you rate the presentations on climate effects and climate adaptation methodologies (Day 1)?		9	6	1			4.5
8	How would you rate the presentations on engineering and non-engineering adaptation options (Day 1)?		11	4	1			4.6
9	How would you rate the presentation on Demonstration Sites Feedback (Day 2)?		8.5	5.5	2			4.4
10	How do you rate the presentation and discussion on the recommendations for Phase 2 (Day 2)?		6	8	2			4.3
AVERAGE OF ALL SCORES:							4.3	
1	Three things learned during the Workshop:							
	Engineering and non-engineering options to drive sustainable solutions (x9)							
	Importance of climate adaptation in all aspects of road engineering: planning, design, construction, maintenance (x6)							
	Importance of climate projections and adaptation strategies to ensure sustainable access (x5)							
	Adaptive capacity will improve by the review of existing policies, engineering practices and manuals (x5)							
	Climate adaptation methodologies and actions plans (e.g. 20 steps) (x4)							
	Issues to be considered in design viz-a-viz climate change impacts - urgent need to implement climate resilient road designs (x3)							
	Climate change effects on low-volume rural roads (x3)							
	How to consider environmental impact in asset management (x2)							
	Awareness about climate change - variability and trends (x2)							
	Different action plans that could be implemented to alleviate problems caused by climate variability and change (x2)							
	Poor road construction renders roads susceptible to climate impacts							
	How environmental changes affect current design assumptions and impact on the economy and development in the future							
	Involvement of other stakeholders to implement resilient solutions to climate change							
	Engineering/technical solutions for high risk areas							
	Overview of the site visits undertaken by project team and adaptation options presented							
	Integration of 'environment' and 'engineering' - impact of environment on roads often neglected							
11	Two and most useful aspects of Workshop:							
	Capacity building and dissemination of knowledge, also involving multi-sector participation (x5)							
	Engineering and non-engineering adaptation options to boost adaptation capacity, particularly focussing on rural access (x4)							
	Climate projections and implementation of appropriate adaptation measures to ensure sustainable access (x3)							
	Demonstrations (trial sections) considered a very important hands-on learning event (x3)							
	Overview of the vulnerability assessment and adaptation methodologies (x3)							
	Importance of non-engineering adaptation options, including policies, strategies and plans							
	Balance to be achieved between economically viable, socially acceptable and environmental friendly							
	Current threats associated with climate change							
12	How could the Workshop have been improved?							
	Greater involvement of other sectorial stakeholders, as well as service providers associated with ERA (x9)							
	Participants to have time to read the material before the workshop (x2)							
	Duration of workshop too short in view of scope and importance of the issue (x2)							
	Impact of location of workshop (its remoteness) may have impacted on attendance other sectorial stakeholders (x2)							
	Expanding the scope of the study (e.g. high volume roads)							
	ERA administers trunk roads, not local/low-volume roads - more regional road authorities should become involved (focus of project)							
	Engineering options / demonstrators should be broadened to include other regions in Ethiopia							
	Site visits should be included in future workshops							
	Cost-effectiveness of adaptation options should be considered							
	Dissemination to a larger audience - seminar or conference							
	Group discussions							
13	Any other comments or suggestions							
	Multi-sector involvement will be required - senior professionals capable of contributing should become involved (x2)							
	Climate resilience aspects of this project are of key importance to Ethiopia to improve road delivery							
	Road sector development plans in Ethiopia and elsewhere should be based on accurate/reliable data on climate							
	Problems and remedial measures presented under "engineering adaptation options" were appreciated							
	Need to brief key stakeholders							
	Capacity building should involve regional research centres, universities and NGOs							
	Local professionals involved in design and construction should be invited to understand their approaches and reason behind those							
	It is pertinent to create awareness among professionals engaged in the road sector, and to build capacity in the process							
	Train-the-trainer programme should be initiated							
	Local partners should be included in the study not only as stakeholders, but fully active and engaged in the entire consulting activity							

Climate Adaptation Workshop held at the Alemgena Training Centre in Ethiopia on 8 and 9 February 2017

Attendance Register

Name	Organisation	Day 1	Day 2
Mohammed Abdurahman	ERA, EO,DDG	X	X
Haileyesus Adamtel	World Bank	X	
Alemayehu Ayele	ERA,RDD, Director	X	X
Deribachew Mezgebu	ERA -RDD	X	X
Nesreddin Mohmoud	Ministry of Transport	X	X
Rehima Mohammed	MEFCC, Ministry of Environment	X	X
Dr. Alemgena A. Araya	ALERT Consultancy Engineers	X	
Abeba Berhanu	ERA		X
Beza Taye	ERA (DB)		X
Woinshot Fetene	ERA, RDD	X	X
Yohanes Abebe	ERA, RDD	X	X
Ehitabezalu Nigussie	ERA, RDD	X	X
Asmera Nassir	ERA, RDD	X	
Wegderes Getu	ERA	X	X
Melesse Tadele	ERA	X	X
Zerai Hadera	ERA,RDD	X	X
Sintayehu Getahun	ERA	X	X
Lelisa Welkeba	ERA	X	X
Negash Abido	ERA,RDD	X	X
Henok Tsegaye	ERA,RDD	X	

Name	Organisation	Day 1	Day 2
Melaku Asefa	ERA,RDD	X	X
Alemu Melese	ERA	X	X
Eyob Zewdu	ERA (Eastern Region)		X
Yonatan Chane	ERA/West Region		X
Abubakar Anwar	ERA/West Region		X
Dawit Belay	ERA, South Region	X	X
Tewodros Dugasa	ERA, DB		X
Shimelis G/Senbet	HEC plc		X
Tewodros Yohannes	HEC	X	X
Getachew Yirga	Transport Design & Construction Works	X	X
Alebachew Abreham	CORE Consulting	X	X
Les Sampson	ReCAP – Technical Manager	X	X
Benoit Verhaeghe	AfCAP Consultant / CSIR	X	X
Phil Paige-Green	AfCAP Consultant / PGC	X	X
Mike Head	AfCAP Consultant / SHC	X	X
Sibusisiwe Makhanya	AfCAP Consultant / CSIR	X	X

