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

AfCAP Project GEN2014C

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Introduction to the Programme and Beneficiaries

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. AfCAP current participating countries are: the Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Malawi, Mozambique, Sierra Leone, South Sudan, Tanzania, Uganda and Zambia.

The Scale of the Challenge

The African continent is facing a potential direct liability of US $184 billion to repair and maintain existing roads damaged from temperature and precipitation changes directly related to projected climate change through this Century. The liability does not include costs associated with impacts to critically-needed new roads, nor does it include indirect socio-economic effects generated from dislocated communities and from loss of rural access.

The African Union believes climate change constitutes a major threat to the continent’s development, and has major implications and impacts on African economies. To this end it is working with African Heads of State and Government, African Parliamentarians and the principals of the four pan-African institutions namely: the African Union Commission, (AUC); the African Development Bank, (AfDB); the NEPAD Planning and Coordinating Agency (NPCA); and the United Nations Economic Commission for Africa (UNECA) to address the problem. The UK’s Humanitarian and Emergency Response Review estimates that globally 375 million people each year are affected by climate-related disasters and recommended that DFID should (as are other donors) integrate the threat from climate change, and other potential hazards, into disaster risk reduction. In many African countries, limited or non-existent funds for adaptation are severely challenging these countries.

There is clear evidence that climate change has already affected the magnitude and frequency of some climate extremes. Particularly vulnerable AfCAP participating countries are Ethiopia, Kenya, Mozambique, South Sudan, Tanzania, and Uganda; however, all African countries are affected. Research and Development is needed to identify the threats that are posed by climate change, to develop adaptation approaches to the predicted changes, to incorporate changes into mid-range...
and long-term development plans, and to secure funding for the proposed and necessary adaptation.

**Bridge washout, Ghana (Courtesy: St Helens Consulting)**

**Climate Projections**

The study has already drawn attention to alarming projections coming out of CSIR’s climate modelling. A key finding from projections of future climate change over Africa is the projected rapid rise in surface temperatures over southern Africa and also over subtropical North Africa (Engelbrecht et al., 2015). Temperatures over subtropical Africa are projected to rise at about twice the global rate of temperature increase. The importance of this result becomes clear if interpreted in terms of the Long Term Global Goal of the United Nations Framework Convention on Climate Change (UNFCC) – which is to keep the increase in global surface temperature below the 2 °C threshold. Even if the global climate negotiations are successful, the southern African interior may still experience temperature increases in the order of 3 to 4 °C during the 21st century. Even more concerning, is that temperature increases for the case of low mitigation may exceed 6° C in the subtropics (towards the end of the 21st century).

The impacts of such drastic temperature increases will be felt not only through the increase in average temperature, but also through extreme temperature events such as heat waves. The southern African region is likely to become generally drier under climate change, whilst East Africa is predicted to become generally wetter (Christensen et al., 2007; Niang et al., 2015). Projections of decreasing rainfall totals are also robust across the Mediterranean coast of North Africa, but over West Africa and the Sahel more uncertainty surrounds the projections (that is, climate models project a mixed signal of increasing and decreasing rainfall totals).

The main projected changes are presented below for a number of African countries (mostly AfCAP participating countries). Towards this end, Figure 1 provides the projected changes across a range of downscaling’s for maximum temperature (left) and extreme rainfall events (right), for the period 2071-2100 relative to 1961-1990 under low mitigation. Here an extreme rainfall event is defined as 20 mm of rain occurring within 24 hours over an area of 0.5 degrees longitude by 0.5 degrees latitude (about 2500 km²).
Similarly, Figure 2 provides the projected changes across a range of downscaling’s for rainfall (left) and average value of the Keetch-Byram drought index (right), for the period 2071-2100 relative to 1961-1990 under low mitigation.

Headlines include:

- Temperatures over subtropical Africa are projected to rise at about twice the global rate of temperature increase.
- Best case scenario for climate mitigation still creates temperature increases in the order of 3 to 4°C during the 21st century. Even more concerning, is that temperature increases for the case of **low mitigation** may exceed 6°C in the subtropics. Drought periods will increase significantly.
- Extreme rainfall events, in both severity and frequency, will significantly increase the number of damaging flash-flooding events, particularly in Eastern Africa. In affected areas road infrastructure will be vulnerable.
- Databases and modelling techniques exist that can provide forecasts at both national and sub-national levels. These can be used to plan and design mitigation measures.

**Addressing Climate Adaptation**

In order to help address this significant threat to Africa’s development, AfCAP has commissioned a major programme, starting in April 2016, with a Consortium comprising the CSIR (South Africa’s Council for Scientific and Industrial Research), Paige-Green Consulting (Pty) Ltd and St Helens Consulting Ltd, 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.

Research is needed into appropriate and economic methodologies for vulnerability and risk assessments; prioritisation of adaptation interventions; and optimisation of asset resilience in the context of rural access. In addition, evidence of cost, economic and social benefit links to rural communities arising from more resilient rural access is required to support wider policy adoption across Africa.

_Culvert overtopping, Tanzania (Courtesy: St Helens Consulting)_{
FIGURE 1: Projected changes in maximum temperature (°C, left) and extreme rainfall events (number of events per grid box per year, right) for the period 2071-2100 relative to 1961-1990, for the case of a low mitigation future. The 10th, 50th and 90th percentiles of the projected changes from an ensemble of regional projections are shown (courtesy CSIR).
Figure 2: Projected changes in rainfall (mm, left) and the average value of the Keetch-Byram drought index (right) for the period 2071-2100 relative to 1961-1990, for the case of a low mitigation future. The 10th, 50th and 90th percentiles of the projected changes from an ensemble of regional projections are shown (courtesy CSIR).
**Programme Objectives**

The most immediate impact is likely to be from extreme climate events such as droughts, floods, storms and cyclones. The ultimate goal of the project is to build enduring capacity in AFCAP participating countries to deal with the impacts of weather variability and climate change on vulnerable rural access in a sustainable manner, from policy to practical levels. This is particularly the case for those countries that are most vulnerable to such effects and where adaptive capacity is low, often being hindered by financial, technical and other constraints.

There are two prime objectives:

1) **Objective A: To identify, characterise and demonstrate appropriate engineering and non-engineering adaptation procedures that may be implemented to strengthen the long-term resilience of rural access.**

   It consists of five Work Packages in order to develop and implement a climate change adaptation plan, these being:
   
   o Assessment of current climate trends and future projections for the geographical region; identification of climate change effects and trends that would impact on rural accessibility and low-volume access roads; and quantification/qualification of their degree of uncertainty.
   
   o Undertake a climate vulnerability assessment (current and future) of road pavements within the geographic region.
   
   o Development of adaptation action plans through a risk appraisal to categorise the nature of risk associated with each vulnerability followed by the identification, assessment and prioritisation of available options to respond to the attendant risks.
   
   o Implementation of adaptation action plans.
   
   o Monitoring and evaluation of the interventions on an ongoing basis with regular review and modification of the plans at predefined intervals.

2) **Objective B: To build capacity and disseminate knowledge.**

   Phase 1 of the project will concentrate on awareness and knowledge building, and Phase 2 on dissemination, capacity building and uptake. In practice, this component of knowledge generation, dissemination, training and capacity building will be active throughout the full duration of the project but will evolve through several stages. Training and capacity building will be important for:
   
   o Understanding the challenges;
   
   o Participation and knowledge sharing/exchange;
   
   o Agreeing a methodology and programme for implementation climate adaptation;
   
   o Developing physical and social resilience;
   
   o Disseminating knowledge and experience.

   The overarching objective of the communications activities under the projects is to enhance the project’s reach, to increase the involvement of targeted stakeholders and to optimise the research, capacity building and knowledge management efforts.

   The Project Team will engage meaningfully, from project inception onwards, with relevant partner-country Road and Transport Ministries, Departments and Agencies/Authorities in a knowledge dissemination and capacity building programme based on the outputs from the research. Capacity building will include a wide range of targets from central government agencies to village groups. Specific attention will be paid to National Road Fund Boards, Scientific Ministries and Environment Agencies, with the cooperation and buy-in of the road authorities.
One of the tools that will be used for knowledge dissemination is the ReCAP website. Regular Briefing Notes will be produced during the course of the 30 weeks for Phase 1 of the project in order to share information (and progress) with the community at large, inclusive of AfCAP participating countries.

The Project Team will ensure that there is a focus on uptake and subsequent embedment of outcomes. This will be 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.

National Climate Officers will be contacted to act as points of reference, centres of knowledge and activity coordinators. These are likely to be based in National Research Centres or relevant Ministries, Departments and/or Agencies.

Following the selection and confirmation of the three AfCAP participating countries for undertaking demonstration programmes, two counterpart researchers from each Country will be integrated in the team and will participate in all in-country activities, inclusive of all engagements with central government agencies to village groups, and especially all site visits to be undertaken in the identified region. It is expected that, through interactions with the team and involvement in all in-country activities, that all pertinent knowledge on all aspects of this study will be transferred to the counterpart researchers.

### Specific Work Packages

**PHASE 1 (Research and Knowledge Sharing) - Year 1**

The sub-activities which link with each deliverable include:

3) Inception Period (two month) during which contacts will be established with African Road and Transport Ministries, Departments and/or Authorities/Agencies in order to familiarise with the project and to engage on its scope and depth;

4) Establishment of a knowledge-exchange network (e.g. web-based) between researchers and Ministries, Departments and/or Authorities/Agencies (two months); innovative aspects could include how to assess and manage current maintenance backlogs already caused by extreme climate effects;

5) Undertaking the research (five months); noting the absolute necessity not to re-invent work already done;

6) Definition of the research implementation programme (two months); encompassing but not limited to: new technologies and innovation, new approaches to community and gender access, reducing impacts to social development, creating more resilient structures and pavements, guidance for improved emergency response and rehabilitation of failures;

7) Partner workshop to consider the work to date and to approve the general thrust of the work to be done; and

8) Dissemination of potential options for climate adaptation and resilience strategies (one month).

**PHASE 2 (Option Testing) - Year 2**

The sub-activities would include:

- Testing of potential climate adaptation and resilience strategies through the construction of demonstration sections;
- Dissemination period during which there would be several workshops involving Ministries, Departments and/or Agencies in all beneficiary countries;
- Arrangements for ongoing knowledge-exchange and handover; and
- Draft and Final Reporting.
Deliverables

- Knowledge-Exchange Network (after four months from award);
- Potential climate adaptation and resilience strategies (after five months from award);
- Programme for implementation of research (after seven months from award);
- Testing Outcomes (after six months in Year 2); and
- Dissemination (throughout the programme, but especially during Phase 2).

Interest and Participation

We wish to establish a database of those interested in this programme. There are several levels of involvement anticipated from Inception contact database through to Knowledge Exchange Network:

- General interest
- Officer in relevant Ministry, Department or Authority/Agency
- Researcher
- National Expert

We will shortly establish a domain for Climate Adaptation on the ReCAP website. This will enable you to register your contact details and to participate in the knowledge exchange programme.

In the meantime, you are most welcome to contact Benoît Verhaeghe at bverhaeg@csir.co.za to obtain further information on this programme.

Disclaimer:

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