Economic Growth through Effective Road Asset Management

Progress Report No. 4 (Final)

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Project No. 10636A GEN2018A

6th February 2018
The views in this document are those of the authors and they do not necessarily reflect the views of the Research for Community Access Partnership (ReCAP), or Cardno Emerging Markets (UK) Ltd for whom the document was prepared.

Cover: RAM Assessment Tanzania

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| Zero Draft | Robert Geddes  
Camilla Lema  
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Robert Kakiiza  
Peter Kome | Mike Pinard  
Nkululeko Leta (PMU)  
Les Sampson (PMU) | 24 January 2018  
29 January 2018 |
| Draft | Robert Geddes  
Camilla Lema  
Charles Bopoto  
Kingstone Gongera  
Grace Muhia  
Robert Kakiiza  
Peter Kome | Nkululeko Leta (PMU) | 6 February 2018 |
| Final | Robert Geddes | | 6 February 2018 |

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ReCAP Completion Report Template

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Abstract

The Africa Community Access Partnership (AFCAP) is providing technical assistance to achieve improvements in asset management performance on selected rural roads networks. The participating countries are Sierra Leone, Uganda and Zambia, with the Western Cape of South Africa providing an example of good practice in rural roads asset management.

This report provides a summary of project activities and progress in the period November 2017 to January 2018. During the reporting period, GEM Advisory Team members visited Uganda for the ReCAP IRIM Conference and the GEM PIT meeting. Team members also visited Tanzania and Zambia. The purpose of the Tanzania visit was to appraise the Tanzania Rural and Urban Roads Agency (TARURA) and other stakeholders of the tools used by the GEM project to assess performance in rural road asset management and to determine the socio-economic impact to the local communities. The Zambia visit provided the first input in the External Communications Component of GEM.

Further discussions have been held within the GEM team on the definition of indicators for monitoring performance in asset management. It is expected that these indicators will become an important part of sector monitoring under the Sum4All initiative.

Progress in capacity development for improved road asset management performance in the participating roads agencies is constrained by lack of funding for maintenance of the roads. No allocations were made for maintenance in 2017 in Tonkolili (Sierra Leone), Chongwe (Zambia) and Kamuli (Uganda).

During the next quarter, the GEM Advisory Team will continue with the development of the External Communications component of the project through a further visit to Zambia to map existing communications networks. It is anticipated that an expert in Road Financing in Africa will be included in the GEM team to support high level policy discussions in the participating countries on sustainable financing of road maintenance. Routine visits will be made by the GEM advisory team to the GEM countries to support ongoing capacity development activities and roll out of the road agency action plans. The capacity building efforts will include training of road agency personnel in the preparation of well-motivated requests for funding from the Road Fund.

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1 Economic Growth through Effective Road Asset Management
### Acronyms, Units and Currencies

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<tr>
<th>Acronym</th>
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<td>$</td>
<td>United States Dollars</td>
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<td>AFCAP</td>
<td>Africa Community Access Partnership</td>
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<td>AM</td>
<td>Asset Management</td>
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<td>ARMFA</td>
<td>African Road Maintenance Fund Association</td>
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<td>ASCAP</td>
<td>Asia Community Access Partnership</td>
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<td>Arab Bank for Economic Development in Africa.</td>
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<td>Civil Design Solutions</td>
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<td>Chongwe Municipal Council</td>
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<td>DM</td>
<td>District Municipality</td>
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<td>GDP</td>
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<td>GPS</td>
<td>Global positioning system</td>
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<td>Highway Design and Maintenance (Model)</td>
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<td>Infrastructure Asset Management Manual</td>
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<td>International Labour Organization</td>
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<td>Information Quality Level</td>
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<td>Low Volume Road</td>
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<td>Ministry of Local Government</td>
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<td>National Road Fund Administration</td>
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<td>Sustainable Development Goal</td>
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<td>University of Birmingham</td>
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<td>Uganda National Road Authority</td>
</tr>
</tbody>
</table>
Contents

Abstract..........................................................................................................................................................iii

Acronyms, Units and Currencies....................................................................................................................iv

Contents..........................................................................................................................................................v

1 Introduction.................................................................................................................................................7
  1.1 Background to the Project 7
  1.2 Purpose of the Project 7
  1.3 Objectives of the Project 7
  1.4 Approach 8
  1.5 Project Process 8
  1.6 Participating Agencies 9
  1.7 Advisory Team 9
  1.8 Purpose of this Report 10

2 Overall Progress...........................................................................................................................................11
  2.1 Country visits 11
  2.2 Meetings and Workshops 11
  2.3 Reporting 11
  2.4 Issues facing the Project 11

3 Piloting the Communication Component in Zambia’s Chongwe Municipality .14
  3.1 Purpose and Objectives 14
  3.2 Visit to the Road Development Agency 15
  3.3 Meeting at the Chongwe Municipal Council (CMC) offices 15
  3.4 Visit to Roads in Chongwe District 17
  3.5 Feedback to Chongwe Municipality and RDA 18
  3.6 Next Steps 19
  3.7 Next Visit to Zambia 20

4 Funding of Road Maintenance....................................................................................................................21
  4.1 Current Status 21
  4.2 Communication at Higher Policy Level 21
  4.3 Support from ReCAP Management and DFID 21

5 GEM Indicators of Performance in Rural Roads Asset Management .................................23
  5.1 Objectives 23
  5.2 Primary GEM Indicators 23
  5.3 Secondary GEM Indicators 24

6 PhD Research Progress Report - Establishing the true value of low volume rural roads in low income countries (Kakiiza Kagaba Robert) .................................................................25
6.1 Progress 25
6.2 Methodology 26
6.3 Data collection and analysis 27
6.4 Analysis 29
6.5 Planned activities 29
6.6 Conferences, Meetings, Presentations and Travel 29
6.7 References 30

7 PhD Research Progress Report: A probabilistic tool to calculate short and medium term rural road network condition as a function of maintenance expenditure. (Peter S. Kome) ................................................................. 33

7.1 Background 33
7.2 The GEM road condition evaluation tool for rural networks (RURALNET) 34
7.3 Description of RURALNET 35
7.4 Conclusion 45
7.5 References 45
7.6 Other Activities 46
7.7 Planned Activities 46
7.8 Acknowledgements 46
Annex I 47

8 Planned Activities for Next Quarter ................................................................. 49

Annex A: Zambia Visit for Communications Component: Programme and People Met ............................................................................................................. 50

Annex B: Draft Terms of Reference for the Africa Road Finance Expert ............ 52

Key Words
Asset Management, Rural Roads, Maintenance
1 Introduction

1.1 Background to the Project
Cardno Emerging Markets is managing a programme of Research for Community Access (ReCAP) on behalf of the Department for International Development (DFID). The programme includes research and capacity building activities in Africa (Africa Community Access Partnership – AfCAP) and Asia (Asia Community Access Partnership – AsCAP). Cardno has signed a contract with Civil Design Solutions to provide consultancy services for the delivery of a regional research project on improved management of rural roads.

The project is known as ‘Economic Growth through Effective Road Asset Management – GEM’ and is initially being implemented in sub-Sahara Africa as part of AfCAP. Sierra Leone, Uganda, Zambia and the Western Cape are participating in the project, but the research process and outcomes are being shared with other AfCAP-participating countries. Some AsCAP countries have also benefited from outputs of the project through their attendance at the Project Implementation Team (PIT) meeting in November 2016. Due to the success of the project, there are discussions underway on rolling out the research process on a wider basis in Africa and Asia.

The African Road Maintenance Fund Association (ARMFA) is expected to provide an oversight role and a possible longer term institutional home in Africa. ARMFA is expected to become increasingly important as a partner in the GEM project given the ongoing challenge of funding rural road maintenance. Contact is being maintained with ARMFA through attendance at their Annual General Meetings, where progress on the GEM project is presented. The next Annual General Meeting of ARMFA is scheduled for 19th to 23rd February 2018 in Ethiopia.

The Implementation Phase of the GEM project commenced in July 2016 and will run until the end of 2018.

1.2 Purpose of the Project
The purpose of the project is to achieve economic and social benefits for local communities as a result of improved performance in road asset management.

The ultimate beneficiaries of the project are rural communities in sub-Sahara Africa and Asia.

1.3 Objectives of the Project
The objectives of the project are as follows:

1. Review literature and reports on existing and recent road management and maintenance programmes and identify ‘what works’ and ‘what doesn’t work’ in the type of environment likely to be encountered in the project areas.
2. Develop a framework for measuring performance in road asset management appropriate to sub-national rural road networks and apply it in selected project areas.
3. Develop simple and appropriate tools for monitoring road condition and apply them in the project areas.
4. Develop simple indicators of economic and social impact of rural roads and monitor them in the project areas.
5. Achieve incremental (and measurable) improvements to asset management performance in the project areas.

1.4  **Approach**

The approach to the project is intended to foster self-reliance in road agencies and encourage greater accountability to road users and other sector stakeholders. It provides flexibility and space for the participating road agencies and their stakeholders to determine their own destinies. The approach focuses more on improved performance in road asset management than on any specific or pre-conceived road asset management systems or institutional, management and funding arrangements. Support to this process is being provided through demand-led technical assistance funded by UK Aid through AfCAP.

1.5  **Project Process**

The development process adopted by the project is summarised in the diagram below.
1.6 Participating Agencies

The roads agencies that are participating in the project are:

- Tonkolili District of Sierra Leone
- Chongwe Municipality of Zambia
- Kamuli District of Uganda
- The Uganda National Roads Authority
- The Department of Transport and Public Works of the Western Cape (RSA).

Three districts in Tanzania submitted AM performance self-assessments and received feedback on their assessments from the GEM Advisory Team. This was then followed by further self-assessment by a wider group of the recently formed TARURA’s regional and headquarters staff.\(^2\)

The project representatives of the participating countries are as follows:

**Uganda:**

- Uganda National Roads Authority: Dr Mark Henry Rubarenzya and UNRA Research Fellow, Emma Mbabazi
- Kamuli District: Eng Grace Mulondo

**Zambia:**

- Road Development Agency: Eng Presley Chilonda and Eng Victor Miti
- Chongwe Municipal Council: Eng Peter Banda

**Sierra Leone:**

- Sierra Leone Roads Authority: Eng Tamba Amara and Eng Mahomed Lahayi
- Tonkolili District: Eng Sallieu Konneh

**Tanzania:**

- Tanzania Rural and Urban Roads Agency: Eng Joseline Kagombora (Research Engineer)

**Western Cape:**

- Eng. Herman Wolff.

1.7 Advisory Team

The CDS team that is supporting the implementation of the project is as follows:

- Team Leader: Robert Geddes

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\(^2\) See separate Report on 2017 RAM Assessment Support Visits to TARURA, Tanzania. 17th December 2017. (Draft).
• Road Maintenance Expert: Kingstone Gongera
• Road Condition Monitoring Expert: Charles Bopoto
• Rural Transport Economist: Camilla Lema
• Institutional and Financing Expert: Mike Pinard
• Communications Expert: Grace Muhia
• Other Technical Experts: Gerrie van Zyl (Road Asset Management).

The University of Birmingham (UoB) is providing expert support in Road Asset Management to the project under the guidance of Dr Michael Burrow. Two UoB PhD candidates are using the GEM project for their research projects, namely Robert Kakiiza (Uganda) and Peter Kome (Sierra Leone).

1.8 Purpose of this Report

This report presents a summary of activities undertaken and progress achieved in the period November 2017 to January 2018. It follows the Third Quarterly Progress Report (to 31 October 2017) and monthly reports for November and December 2017. It includes progress reports by the two University of Birmingham (UoB) PhD candidates who are using the GEM project for their research projects.
2 Overall Progress

2.1 Country visits
The following country visits were carried out during the reporting period:

- Visit of Road Condition Monitoring Expert to Tanzania (Mwanza and Dar es Salaam) from 4\textsuperscript{th} to 14\textsuperscript{th} December (see separate report dated 17\textsuperscript{th} December 2017).
- Visit of Rural Transport Economist and Communications Expert to Zambia from 17\textsuperscript{th} to 19\textsuperscript{th} December (see report in Chapter 3).

2.2 Meetings and Workshops
The full GEM advisory team attended the ReCAP Inter-Regional Implementation Meeting (IRIM) in Kampala, Uganda, from 20\textsuperscript{th} to 22\textsuperscript{nd} November 2017. The Team Leader made a presentation on the GEM project to a plenary session of the meeting on 20\textsuperscript{th} November. The PowerPoint presentation is available from the ReCAP web site.

The GEM Project Implementation Team (PIT) met on 21\textsuperscript{st} November during the IRIM meeting. The report on the meeting is attached to the GEM Monthly Progress Report for December 2017. The PowerPoint presentations made by the PIT participants are available from the ReCAP web site.

Two abstracts have been submitted of technical paper for the SARF/IFR/PIARC Regional Conference for Africa to be held in Durban in October 2018. The titles of the abstracts are:


2.3 Reporting
The following reports were submitted during the reporting period.

- The Third Quarterly Progress Report.
- Tanzania TARURA visit report.
- December Monthly Progress Report including the report on the PIT meeting in November.

2.4 Issues facing the Project

2.4.1 Funds for Road Maintenance
The most significant issue currently facing the project is the failure of the participating countries to provide funds for routine and periodic road maintenance. No funding was
provided for maintenance in Chongwe, Kamuli or Tonkolili in 2017. As a result, it is becoming increasingly difficult for road agencies to effectively implement the project capacity development plans.

The limited availability of funding directly affects any efforts aimed at improving performance under the management and operational building blocks of the road preservation pyramid. Without funding for maintenance works, any recommended improvements to existing arrangements for maintenance are likely to remain theoretical, and it becomes difficult to build momentum and engender buy-in at the road agency operational level. It has not been possible for participating road agencies to show concrete results on the ground, which are essential for the growth and roll-out of the project and to enable road agency staff to take pride in their work and increase their level of accountability. This situation also undermines the efforts to measure socio-economic impacts for local communities as a result of improved performance in road asset management, which is the main purpose of the GEM project.

The budgeting system in all the three participating countries does not make sufficient distinction between capital works and recurrent expenditure. Funds allocated in bulk for road works end up being used mainly for new works and little is allocated to maintenance. Due to the limited resources, the funding is not adequate to meet capital works requirements for the main trunk roads, leaving very little chance for any resources to be allocated to rural feeder roads for capital works and worse still for maintenance. In some cases, the funds are available, but disbursement is constrained by poor submissions by the roads agencies, mistrust between sector institutions, and ‘capturing’ of the implementation role by the road fund. The lack of clear policy that commits the government to road preservation through sustainable funding of road maintenance, as well as to appropriate resource allocation for the various tiers of road infrastructure, is a significant contributor to this situation.

2.4.2 Interaction with, and lessons from, the Western Cape

The Western Cape provincial government of South Africa is participating in the GEM project as an example of good practice in rural road asset management. The first PIT meeting was held in the Western Cape (Caledon) in November 2016 enabling representatives of the GEM participating countries to experience first-hand the approach to RAM and the management systems that have developed in the province over many years. However, subsequent staff retirements and management changes in the Western Cape government constrained the opportunities for further collaboration and joint learning in 2017.

Initial discussions have now commenced with Western Cape officials who attended the PIT meeting in November 2017 on possible capacity building activities for the GEM participating countries. Ideas currently under consideration include:

- Participation by representatives of the participating countries in existing training courses for Western Cape staff on visual inspection of gravel and surfaced roads. The training consists of theoretical and practical sessions over three to four days.
• Two-week study visit by 8 engineers (two from each participating roads agencies and District Councils), with exposure to all aspects of road asset management including data logging and analysis systems, maintenance prioritizing, sourcing of gravel materials, working of borrow pits, blading methods, gravelling procedures, reporting, etc. The process and mechanisms used by the Department of Transport and Public Works to bid for annual allocations for road maintenance would be discussed.  

Both options would rely on an allocation of additional funding to the project from ReCAP or re-allocation of existing finds allocated to each ReCAP participating country. However, it is noted that the above suggestions are aimed at the upper tiers of the Road Asset Preservation Pyramid (Technical and Operational) and will have little long-term impact if the lower tiers (External, Institutional and Funding) are not addressed. Therefore, participation in these activities could be made contingent on clear commitment to resolving constraints at the lower levels of the pyramid. The assessment of this commitment can be based on progress with items on the road agencies’ Action Plans which relate to policy and the external environment. The requirement for the roads agencies to finance their participating in the study visit (including the use of ReCAP allocations) could be used as an additional indicator of commitment.

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3 The Western Cape Department of Transport and Infrastructure receives funds for road maintenance from a provincial government budget allocation. This budget allocation is funded by central government and local taxes. The use of the budget is determined through a transparent allocation system based on rigorous planning procedures.
3 Piloting the Communication Component in Zambia’s Chongwe Municipality

3.1 Purpose and Objectives
The purpose of the External Communications component is to investigate/demonstrate how different media outlets and platforms can be deployed to support effective road asset management by creating awareness at different stakeholder levels and thereby influencing perceptions related to the importance of rural roads. At decision-maker level, this is expected to lead to increased policy support and funding for the construction, upgrading and maintenance of rural roads. At the community level, the communication and outreach activities are intended to promote a buy-in and embed an understanding of how the rural roads are having an impact on the communities. Local communities will be encouraged to hold government to account by:

- establishing a new creative partnership between government, citizens and civil society to help government deliver improved public services;
- enabling citizens and the media to monitor Government performance;
- finding ways for civil society to help Government deliver better public services; and
- making the media an integral part of the model to monitor and evaluate the delivery of public services through, for example, reporting on service delivery failures.

The External Communications component is closely linked to the socio-economic studies currently being carried out in the GEM participating countries. The participating roads agency will package findings of the socio-economic study in a way that they can be brought to the attention of key stakeholders at the local and national levels and clearly understood by them.

Other GEM activities in the participating areas, for example the determination of an agreed level of service for rural roads, will also be communicated to stakeholders through the External Communications mechanism. It is expected that a range of media will be used including traditional print media, radio and television, as well as social media platforms. All media outlets used will need to be in line with current ReCAP channels and agreed with the ReCAP PMU. In addition, any communications at district level will first be cleared with the relevant officials in the Municipal Council and coordinated with the relevant community liaison officers. All communications, including those at district level, must be cleared with the Zambia Road Development Agency (RDA) Communications Department prior to release to any media platform.

The External Communications component is being implemented in Chongwe Municipal Council of Zambia as a pilot for one year.
3.2 Visit to the Road Development Agency

An introductory visit was made by the GEM team consisting of Camilla Lema and Grace Muhia to the Road Development Agency (RDA) offices in Lusaka on the 18th December 2017. A meeting was held with the Director of Communication and Cooperate Affairs, Mr. Anthony Mulowa.

The concept of the communication component was introduced to Mr. Mulowa, who was very positive about it. Mr. Mulowa saw it as a great opportunity for the department to learn and improve on the communication tools that are relevant for the organization. The Director was very helpful in pointing out the role of the communication department in RDA which is:

- to create mutual understanding with the stakeholders; and
- to educate and sensitize the public through the various media tools, for example when the RDA was introducing the road tolls.

The different media tools RDA uses include:

- Bill Boards;
- radio and TV programmes;
- adverts;
- road magazines;
- social media especially WhatsApp; and
- Intra Communication “Voka” speaking within RDA, providing staff with information on what is going on in the organization.

![Figure 3.1: Bill Boards were effective in introducing this toll station in Chongwe District](image)

3.3 Meeting at the Chongwe Municipal Council (CMC) offices

3.3.1 Purpose

A meeting was held at the Chongwe Municipal Council (CMC) Offices on 18th December 2017. The meeting was chaired by Eng. Banda (Director of Engineering). The purpose of the meeting was to establish contact with the CMC and to establish the existing communication channels in the municipality, with the local communities and key stakeholders for rural roads development.
Engineer Banda advised the project team that there had been a meeting that morning (18th December 2017) where the Council approved funds for maintenance of the GEM project roads. The roads had been prioritized because they have economic impact. They are near schools, markets, hospitals and agricultural activity.

### 3.3.2 Existing communication channels in Chongwe

Chongwe is a municipality that is developing hence it combines traditional and modern communication methods. The main channels of communication are conventional: TV and radio and print media, magazines, newsletters, posters in vernacular, local meetings etc. The municipality also tries to use social media such as Facebook and WhatsApp but does not use Twitter as it is not widely used in Zambia. The district is trying to establish its own magazine.

The municipality’s most effective communication tools are:

- Local radio call-in programs where they invite experts to be part of the panel. They arrange facilitators that can control the group, and they discuss topics on roads raised by the public.
- WhatsApp and Facebook where they get instant feedback. They have a Chongwe Municipal Council (CMC) Facebook page but it is not as active as the CMC WhatsApp page.
- Community meetings: The meetings are presided over by the Councillors using local languages. In these meetings, the Council tries to respond to issues raised by the public.

The Municipal Engineer established the Chongwe Municipal Council WhatsApp Page as a platform of communication between the council and the community representatives. The group has been in existence for 5 years and is very active. It involves the councillors of the ward who relay messages from the community to the CMC. It has the following advantages:

1. It provides communication in real time;
2. It provides a platform for instant feedback; and
3. It is very effective in getting location of black spots on the road network.

The Public Relations Officer in Chongwe noted that the communication component would have been useful during lobbying for funds for maintenance as the council would have understood the need of this component and the project.

3.4 Visit to Roads in Chongwe District

The team visited project roads in Kapete ward and Mwalumina ward. The roads are in very poor condition. When it rains, access becomes very difficult for the community. The rainy season lasts from November to March, during which some roads may be closed for up to 2 days.

The communities near the roads are involved in farming. If the roads were to be improved the communities would make more profits, as their produce would be transported more easily to the markets. At the Mwalumina Road there is a problematic spot the locals refer to as 4 Kwacha. This is because when it rains vehicles get stuck there and the locals demand 4 Kwacha to help the driver push the car out of the problematic spot.

The community communicates these types of problem to the council through local meetings and phone calls, though the community said that the meetings are not very effective.

The community was asked if they would prefer to use WhatsApp for communication with the Council, but they were very hesitant as they felt social media is very intrusive. They said that the WhatsApp platform seeks to infiltrate other media on their phones, e.g., camera and contacts when setting it up. However, when the team explained the advantage of WhatsApp they were receptive to trying it.
The nurses at Mwalumina hospital said that they had a great challenge with the road, especially at the 4 Kwacha area. During the rainy season it becomes very difficult for the ambulance to manoeuvre past the problematic 4 Kwacha spot. They have had an incident where a pregnant woman died because she could not access the hospital due to poor roads. If the roads were improved, it would save lives.

The head teacher of Mwalumina Primary School said that during the rainy seasons they ask the students not to come to school to avoid the children getting stranded as there are no means of transport. This has greatly affected the performance of the school.

### 3.5 Feedback to Chongwe Municipality and RDA

The following is the initial feedback provided to Chongwe Municipality and the RDA on how to improve communications at their respective levels:

- The community would prefer to have representatives included in the Chongwe Municipal Council WhatsApp group. That would help the community to be better informed and also to more effectively communicate their problems to the council. The community representatives in this case would be the head teacher, nurse and the headmen.
- The Council should take greater advantage of gatherings like churches, clinic days and under 5 clinic gatherings to communicate with the community.
- The community in Chongwe needs greater awareness of the advantages of social media, especially WhatsApp and Facebook.
- There is need for more mobile base station masts to be set up in the Mwalumina and Kapete areas to enable ease of communication in these areas.
• There is need for more radio programmes on Rural Roads through Chongwe radio station.
• The communication department in RDA is in need of a better internet facility, as the internet in RDA is very restricted. This is critical for the department.
• Both Chongwe and RDA need to be more proactive in their handling and packaging of dissemination/communication of road issues. The media reporters go on ground and the communities narrate their grievances on roads. When the news goes out to public it cannot be reversed. The image of RDA is tarnished.

3.6 Next Steps

Some elements of a communication programme for the RDA are in place in the District. The various media channels that are being used are still at a very nascent stage, with variable degrees of success. At the moment, media tools such as, WhatsApp, radio programmes, community meetings, bill boards and the newspaper seem to be effective, while, Facebook, Twitter, ?, magazines, brochures, snapchat, and television programmes are not as effective.

There is need to harness and upscale the communication activities that are being undertaken by the RDA and CMC. However, this needs to be done within a “Strategic Communication Framework” that would spell out the short, medium and long-term objectives, targets and indicators for RDA and CMC. The strategy would help define the various target segments, their information needs and the feedback mechanisms that can be put in place and the value that RDA and CMC would derive through such communication.

A consultative process is required in producing such a strategy. This will involve ensuring the various stakeholders segments are consulted in respect of their needs, expectations and contributions to the communication strategy.

It is proposed to develop a communication strategy that will unify the way the RDA and the municipal council project themselves to different stakeholder groups. Development of the strategy will involve the following steps:

1. Undertake a detailed assessment of the existing communication tools being used by the RDA and CMC, their effectiveness and responsiveness to the needs of different stakeholders;
2. Develop a stakeholders’ matrix to identify communication needs of different segments;
3. Assess the stakeholders’ views on what they would like to be communicated to them and how they can participate either proactively or in providing feedback; and
4. Prepare a draft communications strategy in discussion with the RDA and CMC, including a budget for the implementation of communications activities.

The communications strategy will, as far as possible, be generic in nature so that is can be applied on a wider basis under GEM.
3.7 Next Visit to Zambia

It is proposed to return to Zambia in February 2018 to undertake the proposed assessment of existing communication tools being used and their effectiveness and responsiveness to the needs of the different stakeholders.
4 Funding of Road Maintenance

4.1 Current Status
No funding was provided for road maintenance in 2017 in the GEM project areas of Chongwe, Kamuli or Tonkolili. As a result, it is becoming increasingly difficult to effectively implement the project capacity development plans, build momentum for the project and show concrete results on the ground.

4.2 Communication at Higher Policy Level
The GEM project currently lacks the influence that is necessary to effect high level policy decision making on good rural road asset management (RAM). Adequate funding for maintenance is an essential element of this. Consequently, there is need for additional interventions, with appropriate expertise, to bridge the gap on strategic higher-level policy dialogue on RAM as part of an effective communication strategy.

This issue was discussed with Chongwe MC and RDA teams during the December 2017 visit of the Rural Transport Economist and the Communications Expert. The Director of Communications and Corporate Affairs in the RDA said that the earlier this issue is addressed the better. A Road Financing Expert on the GEM team would help to initiate policy dialogue with the Ministry of Infrastructure and Housing (in-charge of primary and secondary roads through the RDA) and the Ministry of Local Government (in-charge of district and feeder roads, DCs, MCs) through the permanent secretaries (PSs). The PSs would be able to assign contact persons in their ministries to follow-up on the process.

The national roads fund agencies and their parent ministries in the GEM participating countries are important stakeholders in the dialogue process. It is recommended that the Road Financing Expert should not only pursue the issue of funding for rural roads, but also carry the entire message on good RAM to appropriate policy levels.

Draft Terms of Reference for the GEM Africa Road Finance Expert are included in Annex B.

4.3 Support from ReCAP Management and DFID
The proposed input of the Road Finance Expert will only be effective if it receives full and proactive support from ReCAP Management, as representatives of UKAid. It is recommended that a letter be sent, preferably on DFID letter head, to all three GEM participating countries. The letter should highlight the marked improvements that have been registered so far as a result of the GEM intervention, and the dilution of the potential of GEM due to lack of sustainable funding for maintenance. Unless the funding issue is addressed it will not allow the objectives of the GEM project to be met. The letter should highlight the potential to maximise the benefits of GEM through committed support from partner countries as promised during the selection stage. The letter should note the following:
• The responsibility of the government to support ReCAP projects as partners in the programme.

• Absence of funding for rural roads maintenance, which was expected to be provided to the participating districts in 2017, and the effect this has on progress with the GEM project.

• Encouraging greater commitment of the government in the next year of implementation.
5 GEM Indicators of Performance in Rural Roads Asset Management

5.1 Objectives
The GEM project is developing indicators of performance in rural roads asset management. It is intended that these indicators will have wide application in developing countries for monitoring AM performance. They are also intended to support the “headline” indicator for rural access in developing countries, which is the Rural Access Index (RAI). The definition of the RAI is still evolving but it is essentially the proportion of the population living within 2km of an all-weather road\(^4\). The RAI is currently a Tier III indicator (Indicator 9.1.1) of the United Nations Sustainable Development Goals (SDG).

5.2 Primary GEM Indicators
The following three “primary” indicators have been developed under the GEM project and are being collected in the GEM project areas. The focus of the GEM project is on rural roads and rural access, but in order for the indicators to achieve wide-scale adoption, they have been designed to be applicable to all tiers of the road network.

1. Road Sector Sustainability Index (RSSI). This is defined as “the extent to which the necessary policies, funding and institutional capacity are in place to ensure the sustainable provision of roads”. The RSSI can be applied to any agency responsible for the provision and maintenance of roads. It is measured through an assessment of the performance of the road agency under each of the 6 building blocks of the road preservation pyramid using the GEM self-assessment questionnaire. The 6 building blocks cover “External”, “Institutional”, “Financial”, “Management”, “Technical”, and “Operational” factors. The roads agency to which the RSSI is being applied must be stated.

2. Road Asset Preservation Index (RAPI). This is defined in two ways (which give different results):
   a. “The ratio of the current road network asset value (CAV) divided by the new road network asset value;” and
   b. “A measure of capital investment towards renewing the asset to acceptable/agreed threshold levels.”

The first definition is useful for global comparison of road agency performance as its definition is unambiguous. It is a simple ratio showing the level to which the road asset has been consumed. Its value is likely to remain relatively consistent over time for a particular agency, but showing general trends of improvement or decline. The second definition tracks investments in roads to clear a maintenance backlog, addressing the

\(^4\)Studies are currently underway through ReCAP to review the status of the RAI including its definition and the methodology for measuring it.
question: “how much money is being allocated to address the lost value of the road asset?” The current asset value of the road network is assessed through the visual condition survey used to calculate the Road Condition Index as described below.

3. Road Condition Index (RCI). This is based on a conventional visual inspection of roads in a particular network. Defects on the roads are rated according to their “degree” and “extent”. The scores are given weightings depending on the perceived importance of a particular defect and combined into a single score representing road condition.

5.3 Secondary GEM Indicators

Different aspects of road condition can be determined by analysing parts of the data from the road condition survey. In this way a range of indicators can be defined which determine the condition of certain aspects of the road. These are sub-indicators to the Road Condition Index (RCI). They are useful at a roads agency level for detailed analysis of road condition and prioritising road maintenance works.

The sub-indicators currently in use on the GEM project are summarised in the table below.

<table>
<thead>
<tr>
<th>Name of Index</th>
<th>Abbreviation</th>
<th>Purpose and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Functionality Index</td>
<td>RFI</td>
<td>Provides a harmonised indication of the level of service offered by a road vis a vis comfort, safety and capacity at road level. It can be aggregated to give Network Functionality Index (NFI).</td>
</tr>
<tr>
<td>Condition Index (Pavement)</td>
<td>CIP</td>
<td>Aggregation of degree and extent of defects relevant to the surface layer only, at segment, road and network levels. It feeds directly into the calculation of the Current Asset Value.</td>
</tr>
<tr>
<td>Condition Index (Formation)</td>
<td>CIF</td>
<td>Aggregation of degree and extent of defects relevant to the formation only, at segment, road and network levels.</td>
</tr>
<tr>
<td>Condition Index (Structures)</td>
<td>CIS</td>
<td>Aggregation of degree and extent of defects of culvert or bridge structure components. It feeds directly into the calculation of the Current Asset Value calculation.</td>
</tr>
</tbody>
</table>
6 PhD Research Progress Report - Establishing the true value of low volume rural roads in low income countries (Kakiiza Kagaba Robert)

SUMMARY PROGRESS REPORT January 2018

Important details

Institution University of Birmingham
Program PhD
Title Establishing the true value of low volume rural roads in low income countries
Supervisors Dr. Michael Burrow
Dr. Gurmel Ghataora
Student Kakiiza Kagaba Robert
Location Uganda / United Kingdom
Type of study Split site study

Milestones:

<table>
<thead>
<tr>
<th>No.</th>
<th>Activity</th>
<th>Status</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Planning and proposal writing</td>
<td>completed</td>
<td>Submitted and accepted by UoB</td>
</tr>
<tr>
<td>2.</td>
<td>Literature review</td>
<td>completed</td>
<td>Submitted to UoB</td>
</tr>
<tr>
<td>3.</td>
<td>Data collection</td>
<td>Phase 1 completed</td>
<td>GEM baseline data</td>
</tr>
<tr>
<td>4.</td>
<td>Reporting</td>
<td>Completed</td>
<td>9-month review report to satisfy requirements of PhD</td>
</tr>
<tr>
<td>5.</td>
<td>Data analysis</td>
<td>On going</td>
<td>Based on GEM data</td>
</tr>
<tr>
<td>6.</td>
<td>Modelling</td>
<td>On going</td>
<td>Based on GEM data</td>
</tr>
<tr>
<td>7.</td>
<td>Sensitivity analysis</td>
<td>On going</td>
<td>based on Sierra Leone, Uganda and Zambia data</td>
</tr>
<tr>
<td>8.</td>
<td>Result analysis</td>
<td>On going</td>
<td>based on models and GEM data</td>
</tr>
<tr>
<td>9.</td>
<td>Reporting</td>
<td>Yet to start</td>
<td>Based on UoB reporting standard</td>
</tr>
</tbody>
</table>

6.1 Progress

6.1.1 Completed activities

The following activities have been substantially completed. Final reviews are ongoing for inclusion in my PhD reports.
1. Project planning
2. Literature review
3. Methodology
4. Preliminary (baseline) data collection.

**Project planning**
The project is on course as indicated by the Gantt chart in Figure 6.1 below. As noted the data collection will be completed this year as more modelling will continue until March 2018. Internal research conference is expected later this year. Sensitivity and results analysis are also planned for this year. A 21-month report will also be concluded later in the year.

The original plan has been followed without deviation and this is expected to continue with minor changes

**Project planning**
The Gantt chart in Figure 6.1 below shows the progress of the research against agreed milestones.

![Figure 6.1: Progress of the research against agreed milestones](image)

6.2 Methodology
The methodology for the research includes the following milestones details of which was reported in the previous summary;
6.3 Data collection and analysis

We have completed the baseline road condition and socio-economic data collection for the PhD study. The data to be used is the same data collected for GEM from Kamuli district in Uganda, Tonkolili district in Sierra Leone and Chongwe district in Zambia. More data will be collected later in the year in line with GEM schedules.

All data collected is based on questionnaires and face to face meetings with stakeholders. Collected data indicates some correlation between road maintenance and social economic benefits accruing from the roads in the project areas.

The data collected is associated with 10 villages/ rural centres of population in the project areas. For each a number of socio-economic type, parameters have been collected. A summary of the main items is given in Table 6.1.

<table>
<thead>
<tr>
<th>Table 6.1: Summary of socio-economic parameters collected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
</tr>
<tr>
<td>Population</td>
</tr>
<tr>
<td><strong>Access Related</strong></td>
</tr>
<tr>
<td>Distance from nearest paved road</td>
</tr>
<tr>
<td>Distance from district centre (Kamuli)</td>
</tr>
<tr>
<td>Average travel time to district centre (by different modes of transport) <em>Boda</em></td>
</tr>
<tr>
<td>Average speed (Boda)</td>
</tr>
<tr>
<td>Number of days of the year road closed due to rain</td>
</tr>
<tr>
<td>Average quality of the road measured</td>
</tr>
<tr>
<td><strong>Availability and cost of transport</strong></td>
</tr>
<tr>
<td>Fares on public transport to the district centre</td>
</tr>
<tr>
<td>Fares to Kamuli (Light vehicle; Bus/combi; Bus/combi; Motorcycle (boda-boda))</td>
</tr>
<tr>
<td>Cost of freight transport to the district centre (ton-km) (Truck, light vehicles, Bodas)</td>
</tr>
<tr>
<td><strong>Price of goods</strong></td>
</tr>
<tr>
<td>Prices of goods available in the trading centre (coffee, maize, rice)</td>
</tr>
<tr>
<td>Prices of goods imported into the village (e.g. petrol, soap, sugar, salt)</td>
</tr>
<tr>
<td><strong>Education - nearest school</strong></td>
</tr>
<tr>
<td>Pupil attendance rate</td>
</tr>
<tr>
<td>School journey times</td>
</tr>
<tr>
<td><strong>Road Safety</strong></td>
</tr>
<tr>
<td>No. of accidents on the road serving the trading centre /village for past year</td>
</tr>
<tr>
<td><strong>Health</strong></td>
</tr>
<tr>
<td><strong>Average time to reach the nearest health centre from the trading centre by different modes of transport (by gender and age)</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>Agriculture</strong></td>
</tr>
<tr>
<td>Price of main cash crop produce in the district centre (per kg)</td>
</tr>
<tr>
<td>Average no. of visits by an extension worker to the village</td>
</tr>
<tr>
<td>Price of main cash crop produce in the village/trading centre (per kg)</td>
</tr>
<tr>
<td>Farm-gate price of main cash crop produce in the village (per kg)</td>
</tr>
</tbody>
</table>
6.4 Analysis

Preliminary analysis made so far on the data sets collected from Kamuli, Tonkolili and Chongwe reveal, as expected, some correlations between rural road condition and other parameters such as journey speeds, journey times, agricultural prices, and cost of imported goods. More relationships have been analysed between journey times and cost of imported goods. Other relationships under analysis include the cost of transport and the availability of transport and the cost of transport and the cost of fuel, as well as relationships between school enrolment and times to reach health centres and recreation areas.

More analysis and adjustments including sensitivity analysis will be made in the course of the year 2018. Further interviews will be conducted in the second phase of the project to try to understand the reasons for the different transport, road condition and commodity costs in each trading centre.

Complete statistical analysis of the data will be carried out as well as a multi-variate analysis upon completion of data collection and formulation of draft models.

6.5 Planned activities

The following activities are ongoing;

a) More data collection for second round data sets
b) Modelling – To be concluded in the UK
c) Result analysis of available data
d) Sensitivity analysis
e) Reporting

6.6 Conferences, Meetings, Presentations and Travel

a) Conferences

A draft abstract was submitted to ReCAP for consideration for the 2018 SARF/IRF/PIARC Regional Conference for Africa (Durban, October 2018). Still awaiting response from the conveners. Conference paper and presentation are under development.

b) University of Birmingham visits

Visit to UoB confirmed and flights booked for 9th February to 13th March, 2018. During this period, I intend to substantially complete my literature review (this has not been possible to achieve in Uganda as a number of critical papers have not been possible to access remotely). I will also have a face to face formal review for which I am required to submit my critical literature review.

Other similar meetings and travels are planned for later in the year 2018 and during the year 2019.
c) SLoCaT activities (funded through ReCAP)

Draft 700 article which is under review prepared for ReCAP blog post (The title of my article is “Poor rural transport condemns the poor to stay disconnected and poor”). Collected video footage of local community activity for UoB video for SLoCaT funded through ReCAP. Assisted with weekly Twitter campaign.

6.7 References

The following references have been reviewed in this study so far. More literature will be reviewed as the research progresses.

3. Alemayehu Seyoum Taffesse, Fanaye Tadesse, Pathways Less Explored—Locus of Control and Technology Adoption, Journal of African Economies, 2017, 26, suppl_1, i36
7. Patricia Masikati, Sabine Homann Kee-Tui, Katrien Descheemaeker, Gevious Sisito, Trinity Senda, Olivier Crespo, Nhamo Nhamo, Smart Technologies for Sustainable Smallholder Agriculture Productivity Growth, 2017, 257.
7 PhD Research Progress Report: A probabilistic tool to calculate short and medium term rural road network condition as a function of maintenance expenditure. (Peter S. Kome)

7.1 Background

This report outlines the progress I have made with respect to the research project during November 2017 – January 2018. It describes the progress made towards the objectives of the project (see August – October, 2017 report) with a focus on the development of the probabilistic tool (see Section 2).

7.1.1 Aim and Objectives

The Aim

The aim of the research is to develop a computer-based tool to predict the condition of rural road assets (pavement and drainage assets) under different maintenance budget scenarios and to facilitate risk based maintenance.

The Objectives

The research has a number of objectives (described in the August – October progress report). These objectives are given below together with comments on the progress towards achieving them.

i. To explore the literature on asset management systems with a view to identifying an appropriate approach for rural asset management.  
Progress to date: Substantially complete. With the work done so far, a probabilistic model, with deterioration based on Markov Chains seems to be the most appropriate (see Section 2 below).

ii. To identify the major components of a rural road which require maintenance (by cost).  
Progress to date: Completed. For purpose of the GEM project, the following components of rural roads have been identified:  
a) Carriageway (Materials and Construction type)  
b) Drainages and  
c) Culverts (bridges are being left out of our study)  
(see Section 2 below).

iii. To understand how the major components deteriorate over time.  
Progress to date: Completed. The progress made with this objective is described in section (3.6 and 3.8).
iv. To explore the literature to identify suitable deterioration models for each of the components identified in objective ii.

*Progress to date:* Substantially completed. From the literature, several deterioration models were reviewed. However, the preferred model identified for this work is the Markov Chain deterioration model (4).

v. By means of exploring the literature and consulting with asset managers of rural networks in SSA, develop a concise and structured framework for predicting the total future maintenance requirements over a given planning horizon, for a rural road network.

*Progress to date:* Complete. The approach identified is described below (see sections 2 and 3).

vi. Test the developed framework with data collected from three rural road agencies

*Progress to date:* Ongoing.

As the research progresses objective v) above will be expanded to include the concept of risk-based maintenance.

### 7.2 The GEM road condition evaluation tool for rural networks (RURALNET)

#### 7.2.1 Introduction

This section of the progress report describes the development of the rural road network evaluation tool (RURALNET). The tool is being developed as a simple spreadsheet model. RURALNET processes the observed gradual progression of various defects distributions on the rural network and uses these results to predict the network's condition in future years for a given (known) maintenance standard and budget profile. It is hoped that the tool will assist the various district engineers within the GEM project countries to better plan their respective medium and long-term maintenance investment requirements for their local networks through the use of RURALNET.

#### 7.2.2 Future development

The rural road network evaluation tool (RURALNET) described in this report, is being developed in two stages. The first stage comprised an investigation of the feasibility of developing a computer model which could be used to predict the performance of a rural road network under varying maintenance budget scenarios. The model is based on visual pavement defects captured by the GEM project to evaluate the road surface condition (i.e. gravel loss, rutting, corrugation, potholes, erosion, culverts embankment, scour protection, cell displacement, etc.). The phase 1 model is expanded upon below and its structure is based on similar models which have been developed for linear infrastructure (1). The second stage of the research, will further develop the initial model to incorporate risk (see the newly expanded objective 5 of the report).
7.2.3 **RURALNET tool requirements**

As discussed in the previous progress report (August – October, 2017) the developed tool should:

1. Provide a method of studying the effects of maintenance funding levels on the condition of a rural road network.
2. Predict the total maintenance budget requirement of a typical rural road network in future years and identify future peaks in the requirement for maintenance.
3. Enable studying of the effect of changes in maintenance treatment policies (approved maintenance standards) on budget requirement and the rural road network condition.
4. Provide an overview of the performance of the rural road network over a number of years.
5. Enable maintenance decisions to be informed by risk (*Stage two*).

For the purpose of this research, a road network is taken to be a set of rural roads with similar construction (design and materials, e.g. gravel roads and engineered earth roads), maintenance standard (treatments and intervention limits) and in similar climate zones as these will deteriorate at similar rates. Typical examples of road networks in Sub Saharan Africa which will be included are the class F/rural road network in Sierra Leone, Zambia and Uganda. The GEM rural road networks in Tonkolili, Kamuli and Chongwe will be used to demonstrate the system. The tool may be use by local council authorities and road administrations in-charge of rural road networks, to study the effects of funding or other maintenance policies on the condition of rural road networks under their control. It should be noted that the maintenance funding, referred to above, applies only to treatments which directly affect pavement condition and drainage. At the current stage of development, it excludes activities such as removal of fallen trees blocking the roadway, clearing of agricultural waste from on-road markets, traffic signs etc.

7.3 **Description of RURALNET**

7.3.1 **Overview**

The fundamental assumption made in the GEM RURALNET is that the condition of the network’s roads can be modelled using frequency distributions of observed defect extents and severities. All defects observed on road pavement vary both in extent and severity throughout the rural road network considered. The pavement condition measures proposed are those suggested by the GEM team (3) (see Table 7.1). To date these are being captured through detailed measurement of the extent and severities of various defects on the three rural road networks. It should be noted that the defects and their measures may change during GEM and therefore these measures as reported herein should be considered as provisional. An example of a distribution of severity levels for a selection of defects observed on the GEM gravel rural road network in Tonkolili District, in Sierra Leone in 2017, is illustrated in Figure 7.1. Table 7.1 shows the corresponding defect severities grouped into severity
bands. For the purpose of RURALNET, the first severity band for any defect is assumed to represent parts of the rural road network with little or no signs of defect. For example, in Table 7.1, severity band 1 for rutting represents the proportion of the network on which rutting is imperceptible (approximately 16.18%).

The defect distribution given in Table 7.1 and Figure 7.1 represents a network wide aggregation of road condition. Consequently, a typical place to source all the required data for RURALNET will be the results from the biannual GEM rural road network condition surveys (BGRNCS) currently being undertaken in Sierra Leone, Zambia and Uganda (3). It is planned that throughout this research, the BGRNCS results for 2016 (baseline surveys), 2017 and for the coming years (2018 and 2019) will be used to illustrate the relationships that is built in RURALNET. For example, Figure 7.1 shows typical distributions of rutting, whole carriageway corrugations, pot holes and gravel loss extracted from the BGRNCS results of 2017 for Tonkolili district. This data directly allows the possibility to obtain the proportion of the rural road network with the aforementioned defect severities. For example, it may be deduced from Table 7.1 that the proportion of the network with rut depths greater than 19mm in 2017 was approximately 75.67%. If the above 19mm rut depth is taken to be a critical intervention point in the approved maintenance standards to trigger the need for pavement rehabilitation, it may then be concluded that 75.67% of the GEM rural road network in Tonkolili district required rehabilitation (i.e. blading or regravelling and compaction) as at 2017.

<table>
<thead>
<tr>
<th>Severity Band</th>
<th>Rutting Severity</th>
<th>Proportion (%)</th>
<th>Corrugation Severity</th>
<th>Proportion (%)</th>
<th>Pot Holes Severity</th>
<th>Proportion (%)</th>
<th>Gravel Loss Severity</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>16.18</td>
<td>0</td>
<td>13.82</td>
<td>0</td>
<td>2.9</td>
<td>&gt; 125</td>
<td>13.82</td>
</tr>
<tr>
<td>2</td>
<td>1 - 19</td>
<td>8.15</td>
<td>1 - 19</td>
<td>25.55</td>
<td>1 - 19</td>
<td>12.61</td>
<td>125 - 250</td>
<td>25.55</td>
</tr>
<tr>
<td>3</td>
<td>20 - 40</td>
<td>41.68</td>
<td>20</td>
<td>8.99</td>
<td>20 - 49</td>
<td>32.27</td>
<td>100 - 50</td>
<td>8.99</td>
</tr>
<tr>
<td>4</td>
<td>41 - 59</td>
<td>2.1</td>
<td>21 - 39</td>
<td>17.65</td>
<td>50 - 75</td>
<td>6.89</td>
<td>50 - 25</td>
<td>17.65</td>
</tr>
<tr>
<td>5</td>
<td>&gt;= 60</td>
<td>31.89</td>
<td>25</td>
<td>33.99</td>
<td>&gt; 75</td>
<td>45.33</td>
<td>&lt; 25</td>
<td>33.99</td>
</tr>
</tbody>
</table>

7.3.2 Fundamental Assumptions

The procedures we plan to adopt in RURALNET to model the road network performance will be based on the following assumptions, initially. These will be explored as my research progresses:

1. That the condition of a rural road network can be adequately represented in the form of statistical distributions of defect severities. The literature review has found that this is a reasonable approach and that a number of infrastructure models have been developed on this basis.
2. That all expected deterioration trend for the rural road network will remain stable over a period of time equal to the analysis period and will take account of potential traffic growth rates and the anticipated effects of climate change. Hence the deterioration trend data for past years can be used to predict the condition of a road network over a defined analysis period, provided climate effects are considered.

3. That the maintenance budgets we will be specifying in RURALNET would be spent entirely on maintenance treatments which will directly affect the condition of the assets considered (initially road pavements but later drainage assets will be included).

7.3.3 Outline of RURALNET

RURALNET will be designed to predict the annual change in pavement condition by calculating the effect of maintenance treatments of defect severity levels and then ageing the resulting distributions to predict the severity levels in the following year.

Ideally, a road network should be defined in terms of stretches of roads with the same pavement structure, environment and traffic loading. The rationale behind this is to analyse rural roads which exhibit similar performance in terms of deterioration. The processing involved in the model is then broken into a calculation of the annual progression of defect severities followed by simulation of the effects of maintenance treatments applied in each year. This iterative process is summarised in the steps below and described in more detail in section 3.

1. RURALNET will be initialise by specifying physical characteristics of the road network (e.g. length, width, construction type), annual maintenance budgets, maintenance standards (to be defined by the road agency) and defect severity distributions for the first year of analysis from results of road network condition surveys (BGRNCS).

2. Then it will compute the percentage of the road network requiring maintenance from defect severity distributions and specified maintenance intervention levels (see section 3.2).

3. Next it will compute the percentage of the road network which will receive treatment under the specified maintenance budget limits and maintenance intervention levels.

4. Furthermore, it will compute the interaction between multiple defects occurring on the same stretch of road and predict the effect of maintenance treatments triggered by one defect, on the severity distributions of other defects.

5. Finally, it will predict the condition of the road network in the following year using defined defect progression relationships.

In step 1, the condition of the road network is initialised at the beginning of the analysis period using defect distributions obtained from surveys of road network condition, for example, the BGRNCS baseline survey results. Steps 2 to 5 are then repeated for each year in the specified analysis period as illustrated in Figure 7.2. Within these, the percentages of the road network
requiring each type of maintenance treatment calculated according to specified maintenance intervention levels.

Let’s assume for example, that the feeder roads department (SLRA) and the road maintenance fund administration (RMFA) in Sierra Leone have agreed on a maintenance standard for all rural roads, to apply re-blading treatments when (a certain extent/percent of the) pavements attain a rut depth greater than 19mm. From Table 7.1, this would include 75.67% of the network in severity bands 3, 4 and 5 with rutting greater than 19mm. If, however, the total expenditure requirement for maintenance exceeds the annual maintenance budget, it becomes necessary to limit the amount of maintenance is work carried out to that possible under the given budget. The percentage of the network receiving treatment in any given year is therefore determined from the calculated maintenance requirement, but is limited to the maximum percentage which can be treated under the specified budget. The severity distributions of all defects on the network are then calculated for the following year taking into account the joint occurrence of defects on the stretches of road receiving treatment. See Section 3.5.

7.3.4 RURALNET Simulation Process

RURALNET comprises a number of simulation modules which will perform specific tasks that will be designed to reflect commonly accepted practice in road maintenance. These will include the specification of maintenance budgets and intervention levels. The calculation of maintenance requirements, simulation of the effects of maintenance treatment on road network condition and modelling the pavement deterioration based on defects progression of the distribution which will be measured (observed and recorded).

7.3.5 Specification of Maintenance Standards

In RURALNET, a maintenance standard defines the intervention levels at which various treatments are to be applied and we will be adopting the maintenance standards which the GEM teams and the respective local councils will be approving. Table 7.2 shows a typical example of a maintenance standard developed using the defects severity and extent pictorial charts which has been adapted from the current work by the GEM team to train council engineers. In the adapted example of maintenance standards, reconstruction will be applied when whole carriageway impassability reaches 40% or when whole carriageway erosion is equal to or greater than 60 mm depth. Similarly, when pot hole depth is equal to or greater than 75 mm. Reconstruction will also be applied when whole carriageway corrugation reaches 40% or when rutting is equal to or greater than 60 mm. The table also shows that re-graveling is to be applied on part of the network with gravel thickness less or equal to 25mm. Re-graveling will also occur when pot holes depths are between 50mm -20 mm. Re-graveling will also be applied when whole carriageway corrugation reaches 20% or when rutting is between 20mm and 40 mm. The maintenance standard also specifies the order in which treatments are to be applied. Table 7.2 shows that reconstruction will be the first treatment to be applied on the road network followed by rehabilitation, then re-graveling and finally spot
improvement. This sequence of treatment application can be altered by specifying a different treatment priority order. Within each treatment the defect priority defines the order in which defect are to be treated. For example, Table 7.2 shows that in the part of the road network where we recorded 40% or more impassibility will be reconstructed before sections with erosions depths equal to or greater than 60mm. More discussions are ongoing to establish the combined role of severity and extent of defects in triggering the need for maintenance interventions.

**Table 7.2: Example specification of maintenance standards for GEM road network**

<table>
<thead>
<tr>
<th>Treatment Type</th>
<th>Treatment Priority</th>
<th>Defect Type</th>
<th>Defect Priority</th>
<th>Intervention Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reconstruction</td>
<td>1</td>
<td>Whole Carriageway Impassability</td>
<td>1</td>
<td>&gt;= 40%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WC Erosion (Transverse &amp; Longitudinal)</td>
<td>2</td>
<td>&gt;= 60 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pot Hole</td>
<td>3</td>
<td>&gt;= 75 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WC Corrugation</td>
<td>4</td>
<td>&gt;= 40%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rutting</td>
<td>5</td>
<td>&gt;= 60 mm (i.e. condition band 5</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>2</td>
<td>WC Erosion (Transverse &amp; Longitudinal)</td>
<td>1</td>
<td>40 mm - 60 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pot Hole</td>
<td>2</td>
<td>50 mm - 75 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WC Corrugation</td>
<td>3</td>
<td>21% - 39%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rutting</td>
<td>4</td>
<td>41 mm - 59 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gravel Loss</td>
<td>5</td>
<td>50 mm - 25 mm</td>
</tr>
<tr>
<td>Re-graveling</td>
<td>3</td>
<td>Gravel Loss</td>
<td>1</td>
<td>&lt;= 25 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pot Hole</td>
<td>2</td>
<td>20 mm - 50 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WC Corrugation</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rutting</td>
<td>4</td>
<td>20 mm - 40 mm</td>
</tr>
<tr>
<td>Spot Improvement</td>
<td>4</td>
<td>Pot Hole</td>
<td>1</td>
<td>1 mm - 19 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WC Corrugation</td>
<td>2</td>
<td>&lt;= 20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rutting</td>
<td>3</td>
<td>1% - 19%</td>
</tr>
</tbody>
</table>

### 7.3.6 Calculating the Budget Required for A Specified Maintenance Standard

**Single Defect Rectification**

The percentage of the rural road network requiring maintenance is obtained from the sum of the proportions of the network with defect severity levels which exceed the intervention levels specified in a maintenance standard for the said network. For example, Table 7.2 specifies critical defect severities at which various types of treatments are to be applied together with a priority order for their application. The proportion of the rural road network requiring reconstruction is given by the proportion with (a) whole carriage way impassibility; or (b) corrugation greater than 40%; or (c) transverse and longitudinal erosion deeper than 60mm; or (d) potholes deeper than 75mm; or (e) rutting depths above 60mm. These items are calculated by RURALNET from defect distributions such as those given in Table 7.1 and illustrated in Figure 7.1. This process is repeated for all treatment types given in the maintenance standard.
When a maintenance treatment is applied, it is assumed to eliminate the causative defect. For example, if 31.89% of the network is reconstructed to eliminate the rutting of severity greater or equal to 60 mm, this would alter the defect severity distributions by increasing the percentage of the network with no defects by 31.89%. However, the percentage of the road network that can be reconstructed will be limited by the maintenance budget specified for reconstruction. Charts can be drawn to illustrate the distribution of rut depths prior to the application of a maintenance treatment and the distributions immediately after maintenance and after simulating the ageing process for one year. These charts and graphs will show the three phases used in modelling defect progressions from year to year.

**Multiple Occurrence Defects**

The procedure described above assumes that all defects occur independently of each other. For example, it assumes road sections with corrugation have no other defects. In practice, however maintenance applied to eliminate one type of defect will treat other defects occurring on the same road section. For example, reconstruction applied to road sections with rutting greater than 60mm will eliminate all other defects previously present on the reconstructed sites. In order to take account of this in RURALNET, the joint occurrence of more than one defect on the same section of road is specified. Table 7.3 illustrates example of the joint occurrence of defects using simulated values. The table shows the percentage of a road network with a given primary defects having other secondary defects on the same site. For example, Table 7.3 shows that out of the proportion of the road network which was rutting, 40% also has corrugations, 15% has pot holes, 5% has gravel loss. The two-dimensional table is a simplified form of an otherwise complex multi-dimensional relationship. Many parts of a road network will have more than two types of defect occurring at the same time, and consequently the sum of joint occurrences for a primary defect in Table 7.3 may exceed 100%. For the purposes of this report the data has been simulated as it is unavailable. However, it is anticipated that the data will be available as the GEM project progresses.

The multi occurrence of defects shown in Table 7.3 is used in the calculation of the total percentage of a road network which requires maintenance. As each primary defect is treated, the severity distributions of secondary defects are also affected. For example, if 31.89% of the rural road network with rutting greater than 60mm is reconstructed, this would imply that approximately 12.75% of this, which also had corrugation, will be treated (i.e. 40% of 31.89%). In this case the distribution of corrugation severities is adjusted so that the percentage of the network with no corrugation is increased by 12.75%. The method of adjusting the severity distributions of secondary defects assumes that all severity levels are affected by the applied treatment with the exception of those which would trigger higher order treatments.

In the above example, reconstruction will treat all severity levels of corrugation. However, if the treatment had been a rehabilitation, which does not treat road sections with more than
40% corrugation (see Table 7.2), then only the distribution of corrugations severities below 40% intervention level would be treated.

Table 7.3: Extent of multiple defects on sections of the road network

<table>
<thead>
<tr>
<th>Primary Defect</th>
<th>WT Rutting</th>
<th>WC Corrugation</th>
<th>Pot Hole</th>
<th>Gravel Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rutting</td>
<td>----</td>
<td>40%</td>
<td>15%</td>
<td>5%</td>
</tr>
<tr>
<td>WC Corrugation</td>
<td>30%</td>
<td>----</td>
<td>20%</td>
<td>17%</td>
</tr>
<tr>
<td>Pot Hole</td>
<td>40%</td>
<td>28%</td>
<td>----</td>
<td>30%</td>
</tr>
<tr>
<td>Gravel Loss</td>
<td>20%</td>
<td>15%</td>
<td>25%</td>
<td>----</td>
</tr>
</tbody>
</table>

The procedure described above is carried out in a step wise process. The first step is to take the treatment assigned the highest priority in Table 7.2 and applies it to eliminate the first primary defect which can trigger the treatment. The next step is then to recalculate the distributions of secondary defects which occur on the same road sections with the primary defects according to the multiple occurrences given in Table 7.3. This is repeated for all defects which trigger the treatment, and then for all maintenance treatments in the specified treatment order. When this is completed, the resulting distributions of the defect severities represent the change in condition of the road network due to annual maintenance. In addition, the percentage of the network, calculated to have received treatment, represents the total maintenance requirements for the road network based on the specified maintenance standard.

7.3.7 Maintenance Budget Limits

The preceding section describes how defective parts of the GEM rural road networks can be treated if the available budget is infinite. In practice the amount of treatment that can be applied is limited. In RURALNET maintenance is carried out firstly by treatment priority and then by defect priority as specified in the standards (see Table 7.2). In addition, the user (rural road authority) will also be able to specify maintenance budget limits for each type of treatment in each year of operation. Table 7.4 provides an example of the latter approach using simulated data reflect the expenditure profiles from Tonkolili District council in Sierra Leone, showing the proportion of the annual maintenance budget allocated to each treatment type together with the unit cost of treatment.

Table 7.4: Specification of annual maintenance budget limits

<table>
<thead>
<tr>
<th>Treatment Type</th>
<th>Proportion of Maintenance Budget (%)</th>
<th>Unit Maintenance Cost ($/Km)</th>
<th>Average Scheme Length (Lane Km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reconstruct</td>
<td>20</td>
<td>44</td>
<td>16.8</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>29</td>
<td>17</td>
<td>31.2</td>
</tr>
<tr>
<td>Re-graveling</td>
<td>33</td>
<td>5</td>
<td>52.0</td>
</tr>
<tr>
<td>Sport Re-graveling</td>
<td>18</td>
<td>1</td>
<td>80.5</td>
</tr>
</tbody>
</table>
Maintenance treatments are assumed to be applied until the relevant budget is exhausted. If the total budget requirements calculated for the unconstrained case in section 3.3, exceeds the percentage treatable under the given budget, there will be a short fall under the given budget and part of the road network will remain untreated. If, however, the calculated budget requirement is less than the specified budget, then a surplus occurs, and it remains unused with no transfer of funds allowed between the budgets for different treatment types. It will be possible to perform sensitive analysis using RURALNET to study the effect on budget allocations of varying the percentages spent on different treatment types and by applying a multiplying factor (expressed in percentage terms) on the initially specified total annual budget. This factor may exceed 100% in order to study the effects of larger budget allocations.

7.3.8 Pavement Defect Progression

The final step in the modelling process will be carried out after calculating the effect of maintenance on defect severity distributions. This predicts annual changes in the distribution of road network condition using observed distributions of deterioration in defect severities. As the information is not yet available from GEM, Table 7.5 has been developed using simulated data to demonstrate the example. It illustrates a typical specification of the annualized change in rutting severity. The first line in the table shows the observed progression in rut depth severities. For example, 93% of the road network with no signs of rutting in a given year will continue to show no rutting in the following year, but 4% of the network with no rutting will deteriorate to rut depths between 1 - 19 mm, 2% will deteriorate between 20 – 40 mm, etc. The second line shows the proportion of the network with between 1 - 19 mm of rut depth in the current year. In the following year, 90% of these will remain within the same band, but 6% will deteriorate to the next band between 20 – 40 mm, 3% to between 41 – 59 mm, and so on. It is envisaged that the distribution of defect progressions illustrated in Table 7.5 can be obtained from observed performance of the GEM rural road networks in Tonkolili, Kamuli and Chongwe.

<table>
<thead>
<tr>
<th>Current Rut Depth (mm)</th>
<th>Rut Depth Severity Range in the following year (mm)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1 - 9</td>
</tr>
<tr>
<td>0</td>
<td>93%</td>
<td>4%</td>
</tr>
<tr>
<td>1 – 19</td>
<td>90%</td>
<td>6%</td>
</tr>
<tr>
<td>20 – 40</td>
<td>85%</td>
<td>12%</td>
</tr>
<tr>
<td>40 – 59</td>
<td>87%</td>
<td>13%</td>
</tr>
<tr>
<td>&gt;=60</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 7.5 illustrates how the modelling process simulates defect progressions from year to year and is an alternative method of modelling pavement defect progression to those derived from regression analysis. The defect progression, or ageing process, is performed after maintenance has been applied since it is known that pavements recently maintained can
show signs of deterioration soon after treatment. The relationships shown in Table 7.5 represent a network wide change in condition and may not be applicable to a single length of rural road in isolation. It represents the aggregated effects of traffic loading and the environment. It assumes for example that pavements in the rural road network were designed to take into account current traffic growth rates. However, if it is expected that significant deviations in the traffic loading pattern will occur, the effects of this can be integrated into the ageing process illustrated in Table 7.5 or indeed a separate run of the model will be undertaken using a new defect progression table to account for the expected change.

7.3.9 Calculation of Equivalent BGRNCS Defects Indices

In order both to evaluate the model and to have a common measure of pavement condition, RURALNET also calculates an equivalent BGRNCS defects index for each year of the analysis period. This is based on the BGRNCS formula for calculating the defect indices. Currently, the following indices are defined by the GEM (1):

i. Network Functional Index (NFI)
ii. Network Condition Index - Pavement (NCIP)
iii. Network Condition Index - Formation (NCIF)

The BGRNCS defects index represent the average cost of maintenance required to repair a 1Km length of the road network in the Sierra Leone to an acceptable condition. It is obtained by applying standard unit costs (based on previous and prevailing unit rates in most ongoing projects) to maintenance treatments required to restore the entire rural road network to an acceptable condition. The defects index is calculated from the cost of applying one or more of the following maintenance treatments required to remove carriageway and verge (sidewalk) defects; complete rehabilitation of the formation and gravel layer or thick re-graveling or major spot re-graveling. The cost is then averaged over the total number of 1Km sections in the road network. A similar approach will be adopted in the calculation of the equivalent defects index in RURALNET. The main difference, however, will be that not all of the maintenance treatments included in the calculation of the BGRNCS defect index are applied in RURALNET. In addition, the defect index calculated by RURALNET will be expressed as a percentage of the index calculated for the first year in the analysis period.

7.3.10 Output from RURALNET

RURALNET is designed to provide a number of output tables and graphs containing a wide range of information. These will include summary information of annual maintenance expenditure by type of treatment, the predicted trend in the rural road network condition, the distribution of defects over the rural network and the summary of any surplus or shortfall in the specified maintenance budget over the analysis period. Table 7.6 illustrates examples of a typical structure of results obtainable using simulation data to demonstrate the output.
Table 7.6: Summary statistics from RURALNET

<table>
<thead>
<tr>
<th>Analysis Period:</th>
<th>3 (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Maintenance Budget Specified:</td>
<td>1.5 ($ m)</td>
</tr>
<tr>
<td>Total Maintenance Expenditure Utilized:</td>
<td>1.2 ($ m)</td>
</tr>
<tr>
<td>Total Maintenance Budget Surplus:</td>
<td>0.3 ($ m)</td>
</tr>
<tr>
<td>Network Functional Index (NFI)</td>
<td>37.6 %</td>
</tr>
<tr>
<td>Network Condition Index - Pavement (NCIP)</td>
<td>43.3 %</td>
</tr>
<tr>
<td>Network Condition Index - Formation (NCIF)</td>
<td>57.4 %</td>
</tr>
</tbody>
</table>

7.3.11 Summary of Cost and Average Condition

Table 7.6 includes simulated values used as an example of the summary information calculated by the model for the BGRNCS road network over a hypothetical period 2016 – 2018. For the worked example, the maintenance budget specified for this period is shown to be marginally greater than the total maintenance expenditure calculated by RURALNET. This is a result of sub-optimal allocation of the maintenance budget between the different treatment types simulated in the worked example. Graphs can be used to show maintenance expenditure and maintenance budget to identify the years in which sub-optimal budget allocations occur. RURALNET will also give an estimate of the total budget required to sustain a specified maintenance standard. This will be calculated by the cost of various treatments required to keep defects within the road network at or below the condition specified in the maintenance invention levels as described in section 3.7. A large budget requirement would result from a combination of high maintenance standards (i.e. low defect intervention levels) and high unit cost specified for maintenance treatments. The total requirement therefore reflects the amount of money needed to achieve the specified maintenance standard throughout the road network. In practice, a significant proportion of a rural road network such as the GEM network in Tonkolili district will frequently be below the required maintenance standards and hence RURALNET will compute for the network under study a large backlog in the budget requirement over an extended period of time.

7.3.12 Maintenance Expenditure by Treatment Types

In addition to the summary information described above, detailed information will also be provided on maintenance expenditure, maintenance shortfalls and surplus, and the length of the road network treated each year with different types of treatment. These will be illustrated using graphs and charts.

7.3.13 Road Network Conditions Indices

Only one type of road network condition will be defined in the model representing network wide condition. The visual condition index (VCI) represents the percentage of the road network in ‘good’ condition. This is normally calculated from the percentage of the network which does not require maintenance. The assumption here will be that the specified
maintenance intervention levels will represent both the engineers and road user’s perception of unacceptable road condition. Hence any part of the road network which does not require treatment (i.e. where none of the intervention levels will be exceeded) will be assumed to be in good condition.

### 7.3.14 Equivalent BGRNCS Defects Index Trend

RURALNET can also be used to plot the predicted, trend in the equivalent BGRNCS defects index described in section 7.3.9. A graph of the predicted trend in the equivalent BGRNCS defects index calculated for a rural road network by RURALNET could be drawn it will illustrate the predicted trend in road network condition in similar manner to that illustrated by plots of the Defects Index in the periodic BGRNCS reports.

### 7.4 Conclusion

A prototype model has been developed for the GEM rural road network which can be used to predict the effects of maintenance funding levels on their condition. RURALNET is intended to be used by the engineers, development planners and administrators in charge of road maintenance in the three GEM pilot district councils as a general propose tool to study the consequences of a wide range of maintenance scenarios. It’s designed to be a user-friendly model, enabled to be used with a wide range of rural road networks with different characteristics to be analysed. Detailed results from the model will be viewed using versatile data display modules.

RURALNET will incorporate a versatile mechanism for modelling a variety of defect progressions which can be easily calibrated to match observed network performance. The ability of the model to predict future condition will be enhanced with greater access to more data from the GEM.

Although RURALNET will be developed to a state where it can be applied, its performance will depend on the quality of data used to calibrate the relationship built into it. If time permits, further advances to the model will be made by way of integrating into it vehicle operation cost (VOC) relationships as a function of the pavement condition. In addition, the model will benefit from improved defect progression relationships which take into account both traffic loading and drainage issues.

### 7.5 References

7.6 Other Activities

Within the period under review I have facilitated GEM Sierra Leone team to undertake resurveying exercises within the Tonkolili rural district and its environs in terms of:

1) Repeat of the socio economic surveys across all ten market centres.
2) Repeat of the road asset condition survey including drainage structures on the 250Km GEM rural road network.

Made necessary preparations for the anticipated arrival of the GAT initially scheduled for January 2018.

Coordinated the preparation of country reports and presentation slides for team Sierra Leone to attend the PIT meeting between November 20\textsuperscript{TH} - 22\textsuperscript{ND}, 2017, in Uganda.

Written RECAP sponsored Blog for SLoCaT \textit{(Additional money and commitment are needed to develop and maintain rural road networks and transport services)} and assisted with the collection of video footage for the same. Also assisted with Twitter Campaign and development of video.

Preparing to present a paper at the AM conference in Durban \textit{“The 2018 SARF/IRF/PIARC Regional Conference for Africa in October 2018.”} A draft abstract has already been prepared.

7.7 Planned Activities

The following activities are planned in the next three months:

✓ Continue with literature review.
✓ Progress with the ongoing continuous adjustment and development of the deterioration models (focusing and those which allow for drainage futures).
✓ Visit UoB from January 2018 to March 2018 and From May 2018 to June 2018.

Please find details of planned activities for the next three months in the attached Gantt Chart.

7.8 Acknowledgements

The proposed work described in this report forms part of my PhD research programme which is part of the GEM project under RECAP (Project No. 10636A GEN2018A). The work is carried out under the supervision of the University of Birmingham under the co-supervision of Dr. Michael. P. Burrow and Dr. Gurmel Ghataora. Valuable data will be obtained through the support a team of GEM colleagues and partners supervised by the professional GEM Advisory
team leads (GAT). The financial support of DIFID through ReCAP as main sponsor is also gratefully acknowledged.

Annex I

Figure 7.1 Typical Defect Severity Distributions
Figure 7.2: RURALNET Flow Diagram

1. Initialise Defect Distribution
2. Calculate Total Maintenance Need
3. Calculate Total Maintenance and Effect on Network Condition
4. Calculate Equivalent BGRNCS Index
5. Defect Progression Relationship
6. Calculate Network Condition in “Year + 1”
7. End of Analysis Period?
   - Yes: Output
   - No: Multiple Occurrence of Defect
8. Maintenance Standards
9. Maintainance Budget Limits

Output: Maint. Budget Condition TRENDS, COST SUMMARIES
8 Planned Activities for Next Quarter

The following activities will be undertaken in the period February 2018 to April 2018:

- Continued support to the participating roads agencies to meet the targets of their Action Plans and complete their Asset Management Policy Statements.
- Visits of the Road Maintenance Expert, the Road Condition Monitoring Expert and the Rural Transport Economist to the participating countries to follow up on resolutions passed at the PIT meeting and to continue with capacity development activities.
- Assist the participating roads agencies to strengthen their bids for annual maintenance funds including:
  - Second visit of the Communications Expert to Zambia to assess existing communications tools and conduct a stakeholder mapping exercise, and to prepare a strategic communications plan.
  - Mobilisation of the Africa Road Financing Expert (pending approval by ReCAP PMU).
- Monthly and quarterly reporting.
## Annex A: Zambia Visit for Communications Component: Programme and People Met

<table>
<thead>
<tr>
<th>Itinerary</th>
<th>Date</th>
<th>Time Logistics</th>
<th>Key Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrival in Zambia</td>
<td>17/11/17</td>
<td>Night in Lusaka</td>
<td>• Meeting with the Director of Communication and Corporate Affairs, and the Senior Customer Relations Officer to establish existing communication channels with stakeholders.</td>
</tr>
<tr>
<td>RDA Office in Lusaka</td>
<td>18/11/17</td>
<td>9.00 am – 11.00 am</td>
<td>• Establish contact with the RDA.</td>
</tr>
<tr>
<td>Travel to Chongwe and meetings</td>
<td>18/11/17</td>
<td>11.00 am – 15.00 pm</td>
<td>• Meeting with the Director of Engineering, Assistant Public Relations Manager, and the PRO to establish existing communication channels.</td>
</tr>
<tr>
<td>Field visit to Kapeta Trading Center (TC) – 6.5 km from Chongwe Town</td>
<td>18/11/17</td>
<td>15.00 pm – 17.00 pm</td>
<td>• To get the visual perspective of the communities within and around the TC and how they communicate on developmental-road related issues.</td>
</tr>
<tr>
<td>Travel back to Lusaka</td>
<td>19/11/17</td>
<td></td>
<td>• Establish and evaluate relevant and effective communication channels.</td>
</tr>
<tr>
<td>Travel to Chongwe and field visit to Mwalumina TC – 29km from Chongwe Town.</td>
<td>19/11/17</td>
<td>8.30 am – 12.30 pm</td>
<td>• Visual perspective of the communities and communication channels.</td>
</tr>
<tr>
<td>Travel back to Lusaka and debriefing meeting with the RDA</td>
<td>19/11/17</td>
<td>13.00 pm – 16.30 pm</td>
<td>• Preliminary review of applicable communication channels and media outlets (CMC &amp; RDA).</td>
</tr>
<tr>
<td>Departure</td>
<td>19/11/17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## List of People Met

<table>
<thead>
<tr>
<th>Name</th>
<th>Designation/Organisation</th>
<th>Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthony Mulowa</td>
<td>Director of Communication &amp; Corporate Affairs, RDA</td>
<td><a href="mailto:amulowa@roads.gov.zm">amulowa@roads.gov.zm</a></td>
</tr>
<tr>
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Annex B: Draft Terms of Reference for the Africa Road Finance Expert

Objectives

The GEM project is lacking the link that is necessary to effect high level policy decisions and related actions to improve performance on rural roads asset management (RAM). Institutional strengthening (or transformation) and adequate funding for road maintenance are essential elements of this. There is a need for additional input to the project to bridge this gap as part of an effective communication strategy from local level to higher level policy circles.

An experienced and respected road sector professional will join the GEM project team to act as a Road Finance Expert. The input of the Road Finance Expert will initially be confined to Zambia, as part of the pilot External Communications component of GEM. Key partners for this process in Zambia are the Ministry of Infrastructure and Housing (in-charge of primary and secondary roads through the RDA) and the Ministry of Local Government (in-charge of district and feeder roads through the District Councils and Municipalities).

The Road Finance Expert training will provide support at the central government level as well at the Chongwe Municipal Council (CMC). At CMC level the Expert will reinforce the efforts of other GEM Advisory Team members assisting the Council to prepare detailed work plans and programmes in support of their requests for funding from central government and the Road Fund.

Duties:

The duties of the Road Finance Expert will include:

- To initiate policy dialogue at ministerial level on effective rural roads asset management and financing. Facilitate strategic dialogue and linkages among the responsible ministries for rural roads and the Chongwe Municipal Council, Road Development Agency and the national Road Fund Agency in relation to improving the rural RAM in Zambia, specifically highlighting the following aspects:
  - That current financing approaches are not adequate to achieve the required affordable and sustainable expansion and preservation of rural road infrastructure through adequate maintenance of the existing network. There is a need for policies that seek to either rebalance capital and recurrent expenditure, allow greater attention to be paid to maintenance or expand existing funding sources as well as to develop new funding sources which should be utilised through the asset life cycle.
  - The critical linkage between local and central government organs as regards road funding, in general, and local road funding in particular, noting that what happens at central level is critical to what happens at local level as regards road maintenance funding.
- The need to engender a dedicated political will to strengthen existing procedures, institutions and adequate sources of funding.

- The need at local level to embed asset management culture and life-cycle cost management and practice to ensure increased cost-effectiveness and sustainability of investments.

✓ To provide technical advice to the GEM project implementation team on rural RAM policy and capacity requirements (or gaps) in Zambia and possible effects on sustainability of the project approach.

✓ Based on lessons from Zambia and elsewhere in Africa to propose a flexible framework for high level policy dialogue in AfCAP participating countries as part of influencing strategy for sustainable rural RAM and financing. The framework will take into account key stakeholders in rural roads development including road users.

✓ To liaise with the African Road Maintenance Fund Association (ARMFA) with the aim of establishing its direct involvement in the GEM project as a champion and to provide a possible longer term institutional home (with an oversight role) that will continue to foster performance and efficiency in rural RAM in Africa.

**Required expertise:**

✓ Experience on strategic high-level policy dialogue on rural roads asset management.
✓ Experience in road sector management and roads financing in Sub-Saharan Africa.
✓ Intimate knowledge of ARMFA strategic policies and goals as well as processes.