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Interactions between improved rural access infrastructure and transport services provision

Inception Report

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Cover photo: Paul Starkey: Rural transport services in Jessore, Bangladesh

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Abstract

ReCAP has contracted TRL to research and disseminate how investments in low-volume rural roads (LVRR) impact rural transport services (RTS) and the mobility of people and their goods. The resulting guidelines for improving the LVRR provision-preservation-access continuum should assist authorities to have a more integrated approach to planning, designing and implementing rural access infrastructure investments and rural transport services provision. This should contribute towards the improved mobility of rural communities and socio-economic development. The Phase 1 research will involve reviews of the literature and analyses of existing datasets, and planning for subsequent phases. The report details the team's approach to the LVRR and RTS issues with relevant tables of key parameters, including external issues affecting traffic and transport services. The research will depend on obtaining transport services data which is scarce, as transport services authorities seldom have reliable LVRR data and roads authorities often only undertake traffic counts. The report indicates how a conceptual framework for delivering the subsequent data collection phase will be developed, and provides a preliminary stakeholder analysis, as well as an initial country-based situation analysis. The report provides suggestions for the forthcoming workshop and its timing.

Key words

Transport services improvements; Transport services indicators; Traffic counts; Rural mobility; Rural road outcomes; Rural road impacts; Rural road preservation; Rural road provision

Acronyms, Units and Currencies

$	United States Dollar
4x4	Four-wheel drive vehicle
AADT	Annual average daily traffic,
ADB	Asian Development Bank
AfCAP	Africa Community Access Partnership
AFD	Agence Française de Développement (French bilateral aid agency)
AfDB	African Development Bank
AIDS	Acquired immune deficiency syndrome
ANE	Administração Nacional de Estradas (National Road Administration, Mozambique)
AsCAP	Asia Community Access Partnership
CSIR	Council for Scientific and Industrial Research
DANIDA	Danish International Development Agency
DFID	Department for International Development, UK (UKaid)
DFR	Department of Feeder Roads
DOLIDAR	Department for Local Infrastructure Development and Agricultural Roads, Nepal
DRC	Democratic Republic of Congo
DROMAS	District Road Management System.
DRSP	District Roads Support Programme
DTMP	District Transport Master Plan
DTMP	District Transport Master Plan (Nepal)
eg	for example
ERA	Ethiopian Roads Authority
EU	European Union
FRAMP	Feeder Roads Alternative and Maintenance Program
GBP	Great Britain Pound (UK pound sterling)
GEM	Economic Growth through Effective Road Asset Management Project
GDP	Gross Domestic Product
GIS	Geographical information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (German bilateral aid agency)
GoK	Government of Kenya
GPS	Global positioning system
HDM-4	Highway Development and Management Model
IFRTD	International Forum for Rural Transport and Development
IMT	Intermediate means of transport
IRAP	Integrated rural accessibility planning
IRAP	Integrated Rural Accessibility Planning
IRAT	Improving Rural Access in Tanzania
JICA	Japan International Cooperation Agency
KeNHA	Kenya National Highways Authority
KeRRA	Kenya Rural Roads Authority
KfW	German development bank (originally 'Kreditanstalt für Wiederaufbau' now KfW)
kg	kilogram
km	kilometre
LGED	Local Government Engineering Department
LSFRP3	Liberian Swedish Feeder Road Project Phase 3
LVRR	Low-volume rural road
MELTC	Mount Elgon Labour-based Training Centre
MoTA	Ministry of Transport and Aviation
MOWHI	Ministry of Works, Housing and Infrastructure
MPW	Ministry of Public Works
NGO	Non-governmental organisation
NTA	National Transit Authority
PMU	Project Management Unit
PO-RALG	President's Office, Regional Administration and Local Government (Tanzania)
RAI	Rural Access Index
ReCAP	Research for Community Access Partnership
RED	Roads Economic Decision (software)
RONET	Road Network Evaluation Tools
RTS	Rural transport services
RTSi	Rural transport services indicator
SAPEC	Smallholder Agricultural Productivity Enhancement & Commercialization
SDC	Swiss Development Cooperation
SIDA	Swedish International Development Agency
SLRA	Sierra Leone Roads Authority
SSA	Sub-Saharan Africa
SSATP	Sub-Saharan Africa Transport Policy Program, World Bank, USA
Sum4All	Sustainable Mobility for All (multi-stakeholder initiative coordinated by World Bank)
TARURA	Tanzania Rural and Urban Roads Agency
ToR	Terms of Reference
TP	Technical Panel
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)
UNJLC	United Nations Joint Logistics Centre
URRAP	Universal Rural Road Access Programme (Ethiopia)
USAID	United States Agency for International Development
USD	United States Dollar
VOC	Vehicle operating costs

Executive Summary

The Research for Community Access Partnership (ReCAP), funded by UKAid, contracted TRL to undertaken research to gain, and to disseminate, a greater understanding of how investments in low-volume rural roads (LVRR) impact rural transport services (RTS) and the mobility of people and their goods. The project will research changes in RTS occurring as a consequent of investments in road rehabilitation, upgrade and maintenance. Outputs will include guidelines to assist the planning and implementation of LVRR investments and the improvement of the provision-preservation-access continuum of rural road transport. Through the envisaged improvements in RTS, the outcome should be improved accessibility and mobility for rural communities leading to poverty reduction and improved rural lives and livelihoods.

Phase 1 will include situation analyses, literature review, a regional workshop and planning for Phases 2 and 3, which are subject to Phase 1 progress. Phase 2 will include data collection on LVRR/RTS interactions in selected AfCAP and AsCAP countries, while Phase 3 will concentrate on transport services constraints and improvement options. A 'kick-off' meeting involving the TRL team and ReCAP was held on 1 May 2018.

This report sets out the planned approach to the RTS issues and the LVRR infrastructure issues. RTS issues include the many types of rural people needing access to transport services (varying by gender, age, wealth, occupation, disabilities, etc). There are a wide range of transport services vehicles, including motorcycles, rural taxis, minibuses, pickups and trucks. Service availability depends on market demand, which varies with market days and seasons. Most RTS operate in the informal private sector, and on LVRR there tends to be minimal enforcement of fiscal and safety regulations. Most authorities responsible for transport services have little or no presence in rural areas and do not generally have good datasets relating to RTS. Rural roads authorities seldom collect information relating to RTS, although some relevant information may be contained in traffic counts.

Infrastructure issues relate to planning rural roads, encompassing transport demand issues, social development requirements, agricultural potential and the different costs and impact of all-season and all-weather roads. Interacting engineering issues include road geometry and materials. Preserving road investments through maintenance is crucial for transport services, but rigorous regimes are often neglected on LVRR due to lack of resources.

This inception report relates to planning for the key Phase 1 tasks which include situation analyses, stakeholder engagement, literature review, establishing a framework for Phase 2 and 3, inter-regional workshop, writing the scoping report and preparing a peer-reviewed paper. Preparations have been made for setting out LVRR, RTS and external parameters that may prove relevant during the Phase 1 work and planning the subsequent phases. Initial summaries are provided of relevant information relating to all 17 AfCAP and AsCAP countries, including identification of possible case histories. Further information relating to these counties is provided in an Annex. Stakeholder engagement has started and an announcement requesting inputs and cooperation has been circulated.

Criteria for country selection for Phase 2, include good existing datasets (with transport services information) and local partners willing to engage in the collection of new data. If many good options are available, selection will depend on the quality of datasets and a balance of interesting LVRR/RTS scenarios.

Options for the Phase 1 workshop are discussed, in the context of an on-going dialogue with the PMU. Linking with another ReCAP-related event could provide synergy, and make participation easier for key ReCAP and PMU personnel. From this project's perspective, the venue should be close to relevant examples of LVRR/RTS interactions and have easy visa requirements for participants. Without an obvious relevant large workshop to link to, the workshop could be held in Kenya (good visas and field visits) in association with the 'First Mile' ReCAP project. Our joint discussions with the PMU suggest that a joint workshop could be held after mid-September. This may require minor changes to the timings and milestones on this phase of the project. This would delay the end of Phase 1 by one month but should not adversely impact the schedule for Phases 2 and 3.

A revised workplan has been prepared.

1 Background

1.1 Project overview

The Research for Community Access Partnership (ReCAP), funded by UKAid, commissioned TRL to undertaken a research study to gain, and to disseminate, a greater understanding of how investments in low-volume rural roads (LVRR) impact rural transport services (RTS) and the mobility of people and their goods. This project intends to explore the interaction between the effective use of rural access and its dependency on the appropriate provision and preservation of LVRR, and the resultant changes in rural transport service provision that are brought about through improved sustainable road performance.

As stated in the Terms of Reference, evidence shows there is a strong correlation between poverty and connectivity. Road access in rural areas can improve social welfare by increasing the proximity to and quality of basic services, and broadening livelihood opportunities, including agricultural production and marketing. Increased mobility can improve the uptake and quality of health and education services, particularly in rural or isolated areas. Improved accessibility through the provision of road infrastructure and transport services can improve health and education outcomes by increasing attendance at clinics and schools and improving staff retention. Rural communities benefit from road infrastructure to allow them to reach markets, medical facilities, schools and income-generating opportunities. However, most rural people in developing countries do not own motorised transport and therefore depend on various types of transport services for their mobility and access to services and earning potential.

The many benefits of LVRR are largely dependent on a sustained level of performance linked to there being appropriate and affordable transport services: rural roads must be fit for purpose in terms of facilitating the movement of people and freight. Currently, infrastructure provision and preservation is largely disassociated with service provision. Therefore, this project will examine the relationships between LVRRs and transport services, and the links between LVRR investment planning for provision and preservation and the actual achievement in terms of rural transport provision.

1.2 Project context

As stated in the Terms of Reference, the overall aim of the project is to research changes occurring in rural transport provision consequent to the rehabilitation or upgrade and improved maintenance of LVRR and networks, and to help identify and optimise transport solutions to poverty caused by poor access.

A secondary purpose of the project is to identify other constraints to transport service expansion caused by supply and demand relationships in the rural transport sector. An example of this is where the road has been adequately improved and maintained to an all-weather standard (whereby the road can be used all year round and during heavy rain), but the supply of rural transport services (RTS) continues to be deficient, leading to continued inaccessibility. A low density of demand for RTS, caused by low population density, and exacerbated by weak institutional structures and poor competition and regulation, can inhibit the provision of transport services in rural areas despite the road being in relatively good condition and providing all-season access.

The latter phase of the project will review the circumstances in which private sector operators (including formal sector operators) can improve rural transport services provision. This phase will consider the enabling factors required to generate market-based solutions, within the provision-preservation-access use continuum. The potential for public-private partnerships may also be explored in the context of RTS provision as part of this continuum where the road asset (provision and preservation) is generally the domain of the public sector, and the services that use the asset are generally private sector entities.

2 Research Objective

2.1 General

As stated in the Terms of Reference, the core objective will be to examine the conditions in which transport services succeed or fail, and the relevance of infrastructure condition and level of service to that outcome.

Output: definitive guidelines on how the provision-preservation-access continuum can be improved in support of better livelihood opportunities for rural communities and have a positive impact on poverty reduction.

Impact: to improve accessibility and mobility for rural communities and to improve the overall livelihood outcomes of those communities, and, in particular, vulnerable groups and individuals within those communities.

2.2 Research

In accordance with the Terms of Reference, this research will explore how infrastructure projects are planned, designed and implemented in relation to the end user and the extent to which projected demand for transport service provision is factored in to the planning process. It will take a retrospective look at selected LVRR projects in Africa and Asia to examine whether transport service objectives and accessibility outcomes are achieved as a result of the planned investment in road infrastructure. In doing so, it will determine whether LVRR are fit-for-purpose for the generated traffic post-construction, rehabilitation or upgrade, and under what conditions these roads may be over- or under-designed relative to potential and actual demand for passenger and freight trip-making.

The results of this research should eventually lead to:

- A good practice approach to the planning, design and maintenance of new, rehabilitated or upgraded LVRR and networks that result in improved service access,
- Better advice to road planners and engineers on how to engage with beneficiaries of the road infrastructure, including the end user (households, farmers, transport operators, etc), at the design stage, to optimise integration between roads and transport services,
- Assessment of the effectiveness of different engineering solutions on wider transport service provision and accessibility based on empirical evidence,
- Better understanding of the role of the private sector in delivering RTS, the institutional limitations of providing RTS within government structures, and identifying enablers for public, private partnerships where appropriate.

3 Implementing Entity and Contract Start-up

This research project, is being implemented by TRL, under a ReCAP contract that commenced on 1 May 2018. The TRL team for Phase 1 comprises:

- Paul Starkey Team Leader, Transport Services Expert
- John Hine Senior Researcher, Sociologist/Economist
- Robin Workman Senior Research Engineer (Asia)
- Andrew Otto Senior Research Engineer (SSA)
- Greg Morosiuk TRL Project Manager.

An initial 'kick-off' meeting was held on 1st May 2018 at TRL with all the team members and with two representatives of ReCAP. The ReCAP personnel were:

- Les Sampson, ReCAP Team Leader (by Skype connection)
- Annabel Bradbury, ReCAP Deputy Team Leader and Transport Services Research Manager (in person)

The meeting included wide-ranging discussion of the context, importance and research expectations of this project and the involvement of partner countries. Specific issues included the logistics and organisational modalities of the Phase 1 workshop. These various issues, taking into account the kick-off meeting exchanges, will be presented later within this Inception Report.

4 Approach and Methodology

4.1 Understanding of key issues

Access and mobility are essential for all rural people (including women, men, children and vulnerable people), in order to access health facilities, markets and agricultural supply and marketing chains, education, work, livelihood opportunities, civic responsibilities, recreation and social events. As noted in the ToR, most rural people in developing countries do not own motorised transport, and they depend on transport services for personal mobility and the movement of freight. Rural roads allow people access and the passenger and freight vehicles moving on the roads provide them, and their goods, with the necessary mobility for their lives and livelihoods.

In some cases, climate may impact negatively on accessibility, and such impacts could be increased (or decreased) through climate changes. For example, during heavy rains, roads and water crossing structures can be washed out preventing normal transport services, leaving communities stranded. Similarly, dry periods can result in excessive dust, reducing the safety and comfort of transport services.

Rural people are not homogenous, and there are many types of rural transport users, with various transport needs. People differ by gender, age, occupation, wealth, social groups, abilities and other socio-economic characteristics. Different types of people, and diverse individuals, have distinct transport priorities. Daily, long-distance commuter-type village-to-town transport tends to favour men, while women often require multi-purpose trips (e.g. to the school, clinic and market) and favour high-frequency, local transport service modes. Women tend to be more discouraged than men by overcrowded vehicles and high fares. There are also people who do not use RTS, sometimes due to lack of resources or due to lack of suitable vehicle types (e.g. older persons and people with disabilities). Therefore, this research will not consider RTS users as homogenous.

Similarly, there is a diversity of different transport services modes, with a range of advantages and disadvantages for the various stakeholders. Their merits and demerits may be perceived differently by the various users, operators and regulating authorities. Depending on the country, motorcycles, rural taxis (including pickups and jeeps), minibuses, midi-buses and trucks (of various sizes) are generally the most widespread rural transport types. However, there are many more options that are used in certain countries, including bicycles, animal-drawn carts, three-wheelers (pedal, motor and electric), tractors (2- and 4-wheelers), passenger trucks and large buses. The operating costs, market-demand requirements and typical tariffs vary greatly between the modes, as do the infrastructure requirements and interactions. There can be changes in the modal distribution of transport service vehicles, as infrastructure or transport demand changes by seasons or over a period of years. Therefore, this research will not consider RTS as static or having homogenous infrastructure requirements.

Central to this study is the idea that access provision (building infrastructure), access preservation (maintenance) and transport services (mobility for people and goods) are all interlinked and essential for rural access. The rural access continuum that includes provision-preservation-services is central to this study. Unfortunately, in the past few decades, national road programmes (and their supporting donors and development banks) have seldom embraced such an integrated approach. Road agencies have tended only to pay lip service to the importance of transport services. Reductions in vehicle operating costs and improvements in transport services have generally been cited as justifications for investments in access provision and access preservation. However, rarely have there been systematic studies relating to this, with pre-investment baseline data on transport services (modes, prices, frequencies, quality) followed by comparable post-investment data on transport services, repeated at intervals. Such studies would be invaluable in the context of this research, but such datasets have seldom been collected by road authorities. While traffic count data is sometimes collected, this is rarely systematically recorded or sufficiently disaggregated to allow reliable assessments of transport services. This will make the present research challenging, as we will have to examine and interpret publications and evaluation reports that may have incomplete datasets relating to transport services.

The project has two major underlying topics that are intertwined together in the rural access provision-preservation-services continuum. In most countries, in the past, these were examined separately. In this

research, they will be studied together. The rural infrastructure issues include the type of infrastructure available (e.g. gravel road, concrete road, bridges), the built parameters of the infrastructure (e.g. geometry, layer thicknesses, gradients) and the condition of the infrastructure (e.g. its surface condition in terms of potholing, slipperiness, roughness). The rural transport services issues will include the types of transport modes available (e.g. motorcycles, taxis, minibuses, buses), the fluctuation in numbers and trips within each mode, the cross-modal fluctuations, the reasons provided by stakeholders for these changes, and suggestions for infrastructure improvement to foster growth in RTS provision. As far as practicable, the project will try to include time-series studies on the state of infrastructure at any point in time and the corresponding dynamics of transport services at that time. The data to be considered in the study are the 'before-improvement' and the 'after-improvement' state. Notwithstanding this, the 'after-improvement' state may consist of deterioration in the state of the infrastructure (e.g. increase in roughness of a re-gravelled section of road) and corresponding changes in transport services dynamics. As cycles of improvements and deterioration can span many years, this project duration will not be long enough to be able to witness full cycles of improvements and deterioration. However, through examination of records and interviewing of key informants, it should be possible to provide useful information for preparing guidelines and recommending policies relating to both infrastructure and transport services.

Sometimes, LVRR are built primarily to allow access for sector-specific commercial transport, such as vehicles of agricultural, forestry, fisheries, mining or retail enterprises and/or for sector-specific services. However, in most low-income countries, the provision of LVRR infrastructure has usually had an intrinsic aim to encourage the development of transport services to allow local people to access markets and services. This is particularly the case in previously unconnected rural areas where the population are often the poorest and most deprived. Unfortunately, the ways that transport services develop have not always been taken into account appropriately when infrastructure has been planned and prioritised. This can lead to good roads with little or no traffic, and poor roads that are over-used. We have examples of these and intend to gather further case histories to provide valuable lessons and guidelines to facilitate better practices in the future.

In some countries, the planning links between infrastructure provision/maintenance and transport services can be distorted by political considerations and corruption. Even when there is a functional and appropriate rural road planning system in place, it can be vulnerable to overriding political needs and corruption associated with road budgets and contracting.

In assessing infrastructure-transport services interactions, it will be important to take into account that the rural road network is constantly changing as a result of investment, weather or traffic. Adjacent, connecting and parallel roads may be improved, maintained or alternatively fall into serious disrepair. Where there are dense networks, traffic diversions will be spontaneous as transport services tend to avoid roads in poor condition and take advantage of roads in good condition (provided the transport demand is there). Experience suggests that it will be important to identify, and where possible keep track of developments that occur on the surrounding network (Hine and Bradbury, 2016). Roads selected as 'controls' will not remain in constant condition. Hence care will need to be taken with interpreting changes in transport services patterns between roads identified for infrastructure-services interactions and their 'controls'.

Interpreting the interactions between access provision-preservation and transport services will not be easy, due to the great variability of local circumstances and their changes over time. As an example, large year-by-year fluctuations have recently been observed on rural roads in Ethiopia with overall motorised traffic volumes increasing by 88% between 2015 and 2016 and then declining by 40% in 2017. Over the same period there were also major declines in bicycles, animal-drawn carts and pack animals as well as an increase in pedestrian traffic. The explanation almost certainly relates to periods of drought that have affected both farming incomes, the movement of crops, and also government measures to provide relief to adversely affected populations *(WABEKBON, 2017).*

Following earlier developments in South East Asia, there has been a dramatic increase in motorcycle populations in Africa over the last ten years (often amounting to an increase of 40% per year). This trend is also seen in many parts of Asia. This has translated into a rapid increase in the availability of motorcycle taxis in many rural areas. Such long-term trends will need to be carefully monitored and taken into account in any analysis. The recent growth of motorcycle traffic in some countries has meant that motorcycles are

often the most common vehicles on rural roads. However, motorcycles were not an important issue when many of the existing road standards were developed, transport services and road safety regulations were established, roads were built, maintenance planned and baseline-data obtained. In parts of Asia (including Myanmar) and parts of Africa (including Liberia), motorcycle trails have been constructed to allow transport services (motorcycle taxis) to carry people and goods between off-road villages and the road network. The complicated interactions between motorcycle-based transport services and infrastructure provision and preservation appear quite dynamic, and have yet to be fully researched and issues addressed.

There are numerous issues relating to RTS that will require sensitivity when discussing with stakeholders and developing the guidelines. The issue of motorcycle trails can be sensitive if stakeholders consider them as a 'second-best', inferior option compared to rural roads (as opposed to complementary and synergetic infrastructure that can help to provide equity in rural mobility). Other key issues include compliance with safety standards, insurance, vehicle fitness and loading levels, regulatory enforcement and corruption. Regulatory compliance is generally poor for RTS, with passengers travelling on the roofs of jeeps and buses, hanging onto trucks and/or sharing the driver's seat. Rural motorcycle taxis regularly carry multiple passengers. Some of the safety and regulatory issues that relate to motorcycles and three-wheelers on LVRR are currently being researched under the ReCAP RAF2114A Project, and the outputs of this should inform this research in appropriate ways (Bishop et al, 2018).

National authorities, including road safety authorities, tend to consider non-compliance as a black-and-white issue, requiring only enforced compliance. However, rural enforcement officials tend to be more understanding and lenient (and in some countries may also benefit from corrupt payments). The regulatory and compliance issues are often closely linked to the local provision-preservation-services interactions. Transport operators argue that they have to overload to make a profit on the poor roads. Passengers dislike overcrowding, but due to the scarcity of transport services, regard discomfort as better than not travelling at all. From personal observations, the oldest and most overloaded vehicles tend to be seen on rough rural road, and newer vehicles complying with loading levels are more likely to be seen on better roads. This is not always the case, and correlation is not the same as causation. However, arguably, better roads, together with an element of enforcement, do appear to lead to safer vehicles and less overloading. In rural areas, the comparative advantages of motorcycle taxis are emphasised on trails, poor roads (motorcycles can avoid many potholes) and for short, timely journeys. With improved roads, and increased transport services, there may be modal shift away from motorcycle taxis, towards more conventional transport. We intend to investigate the provision-preservation-services interactions associated with safety and compliance issues, and intend to tackle the subject sensitively, aware of the different stakeholders' opinions.

4.2 Overall approach to implementation

We will take an integrated approach to the rural access provision-preservation-services continuum. While the team members will have their own tasks and responsibilities, we will work closely together at all stages, so that our various skills and experiences will be synergetic as we consider infrastructure issues and transport services, and their interactions. We will promote this integrated approach through our literature review, workshops, scoping report and output papers. In the following sections we will highlight some transport services issues and infrastructure issues, but this does not detract from our overall integrated approach. This will be carried through Phase 1 and its framework planning and into Phases 2 and 3.

Phase 2 field work will have a high level of provision-preservation-services integration and synergy. In particular, we envisage Focus Group discussions with transport users and with transport services operators that will be part of both the transport services surveys and the infrastructure surveys. We anticipate that these will involve road authorities, transport authorities, road safety agencies and other key stakeholders such as rural transport operators and users in several different Focus Groups for discussions on road condition, road planning experiences and the impact of infrastructure on transport services. Local transport operators' priorities for spot Improvements will be highlighted in some groups. As a result of our integrated approach, we envisage that the numerous project outputs will encourage a more integrated approach within AfCAP and AsCAP countries to the provision-preservation-services continuum.

4.3 Approach to transport services issues

As noted above, we recognise the diversity of rural transport users and the diversity of transport types. We understand that the various transport modes have different characteristics. They may have differing transport service 'niches', meeting various aspects of the transport demand depending on the available infrastructure design and quality. The approach will encapsulate the diversity of users, the diversity of transport modes and the dynamically changing transport services provision, varying greatly within and between years, affected by road conditions, seasonality and many other factors.

Many transport services users want transport services that are cheap, frequent, predictable, safe and comfortable. These may also be the aspirations of the transport services regulators too. These will be key issues to address when undertaking literature reviews, workshops, field research and output publications.

We also understand that RTS are operated by the private sector (mainly the informal private sector) who have to make a profit, which is generally a daily profit, not an average profit over time. Therefore, we will research (through literature reviews, stakeholder discussions and Phase 2 fieldwork) the ways in which transport operators endeavour to ensure their profits, and the implications of this for transport users, and the ways different infrastructure conditions alter the options. Issues to look at (related to infrastructure quality and transport demand) will include high loading levels (overloading), queuing for loads, high tariffs and cartels. Transport services regulation and enforcement (and possible corruption) will be inter-related issues that will need to be considered, noting that the costs of transport bribes are likely to be converted into higher tariffs and/or higher loading levels.

4.4 Approach to infrastructure issues

Infrastructure provision and preservation is a key aspect of this project and must be considered within the context of a joint approach to developing transport services on rural roads. Some aspects of infrastructure provision and preservation likely to be considered are provided in the following paragraphs.

4.4.1 Planning

Most countries have systems to prioritise rehabilitation, upgrade and maintenance of LVRR network assets. However, transport services as such and their potential use/impact may not be specifically included in this process. Also, there are sometimes hidden or sensitive factors that influence road planning This can lead to investment in infrastructure that does not necessarily reflect a proportionate, subsequent increase in transport services. This will clearly result in the under-utilisation of government resources.

An example of prioritisation criteria can be seen in Nepal, where a District Transport Master Plan (DTMP) is produced in each District. This relies on several factors to identify and prioritise roads that would provide access with respect to:

- Settlement areas, depending on the demography of the area
- Areas with high agriculture, horticulture or livestock production potential
- Economic generators, such as businesses, markets or tourism
- Service centres, such as health centres, schools, government offices or communication centres
- Potential development sites, such as hydropower, mines, etc
- Environmental issues and potential impacts
- Areas of special needs, such as poor areas, areas with disadvantaged groups, historic sites, religious sites, etc
- Other direct linkages with transport services

All criteria are scored and weighted, which takes into account cost of the intervention and traffic (or projected traffic) in order to prioritise the roads. However, transport service development is not specifically taken into account in this process. A review undertaken for the District Roads Support Programme (DRSP) in Nepal (Stickland, 2009) highlighted some of the issues that can arise when transport services development does not evolve following road construction. The review found that traffic was very slow to

increase on new roads, especially bus services which took some time to establish. There were also other factors that distorted the use of transport services, such as the formation of cartels which restricted services and kept prices high.

Often planning of road networks is carried out at the district or local administration level. This is appropriate if it includes local opinions and needs. However, inter-district planning is less common and in some cases parallel roads have been constructed either side of a district boundary, which in the case of Nepal is often a river. If districts were to liaise more when planning roads, this could be avoided by, for example, constructing a bridge instead of several kilometres of parallel road.

Under Phase 1 of this project, it is intended that the LVRR planning and prioritisation processes of selected countries will be reviewed to understand the extent to which transport service provision is considered in that process.

4.4.2 Alignment

The horizontal and vertical alignment of roads will have an influence on how and what transport services develop and how they are operated. Rural roads often are not designed to specific standards, especially earth roads, and, unless upgraded, they are more likely to include extremes such as tight curves and steep gradients. These factors will influence what types of vehicles are able to travel on such roads, and even whether a particular vehicle is able to negotiate the alignment. In some countries there may be a practice to open roads in steep terrains using a bulldozer without any formal alignment or design, often leading to steep gradients up to 20% and tight hairpin bends that restrict the safe use of vehicles. Under these circumstances larger vehicles such as buses and heavily laden trucks will not be able to pass, and this will influence the range of transport services that can operate.

In road provision planning, the financial limitations will also influence the engineering decision. It is sometimes cheaper to follow low-lying terrain than to provide an alignment through hills and mountains (due to the earthworks). Sometimes, ridge-following routes may require fewer bridges and structures. In either case, avoidance of settlements in mountainous terrain or by-passing communities in river-dissected plains will mean that roads are not as highly utilised as they might have been. The transport services that could have been attracted to the route no longer develop due to the low passenger numbers, as communities remain inaccessible.

4.4.3 Agricultural potential

The construction of roads has often been justified on the basis of agricultural potential in the area. However, the roads themselves must be appropriate for this purpose in order to stimulate agriculture and agricultural marketing in an area. In general, agricultural freight costs per tonne-kilometre decrease with increased vehicle freight capacity, with human porterage often being the most expensive form of transport. The profitable use of agricultural freight vehicles depends on the amount of produce to be transported and the state of the access infrastructure. The current ReCAP project ‘Evaluation of the cost-beneficial improvement of first mile access on small-scale farming and agricultural marketing’ (RAF2109A) is looking at the relationship between the condition of roads and its effect on perishable crops. In general, if ‘first mile’ roads are in poor condition, few freight transport modes are available and freight costs are high. Poor road condition also increases the wastage due to crop damage. This in turn leads to lower crop values, less potential farm income and lower economic benefits from the access infrastructure. As the transport services necessary to stimulate agricultural production and marketing are greatly affected by road infrastructure, the ‘first-mile’ research findings relating to road conditions and market linkages will be used to inform this project.

4.4.4 Social development

Roads are often constructed with one of the objectives being the provision of access to social services. Services such as health centres and schools are often constructed close to roads in order to make them more easily accessible. However, this is not always to the benefit of the poorest and most disadvantaged in

society, who tend to live further from the road and are less able to afford transport services. Planning of roads should take into account the full picture of the road network in an area, and also between areas.

Moreover, this approach is only successful if integrated development programmes are pursued. Provision of access should be developed in tandem with provision of schools and hospitals. Under Phase 1 of this project, we will review and outline the road planning process of a selected number of countries and evaluate whether guidance is offered on providing and maintaining access to social services.

4.4.5 Seasonal disruptions

The status of a road in terms of 'all-season' or 'all-weather' is likely to influence how transport services develop. All-season roads can be used most of the year, but may be temporarily impassable due to climate impacts in rainy seasons (Roberts, Shyam and Rastogi, 2006). All-weather roads have higher standards and significantly greater construction costs and can be used on all days of the year, including during heavy rain. All-weather roads are generally better for transport services, as transport operators can rely on the road to be open every day and can run a regular service. Costs are predictable and can be planned and budgeted for. Where roads are vulnerable to closure and disruption (during poor weather or for part of a season), the transport operator will be less ready to establish a service as there will be potential costs when vehicles are stranded or when they cannot travel, sometimes for several days. This also tends to make fares more expensive for vehicles that operate on seasonal roads.

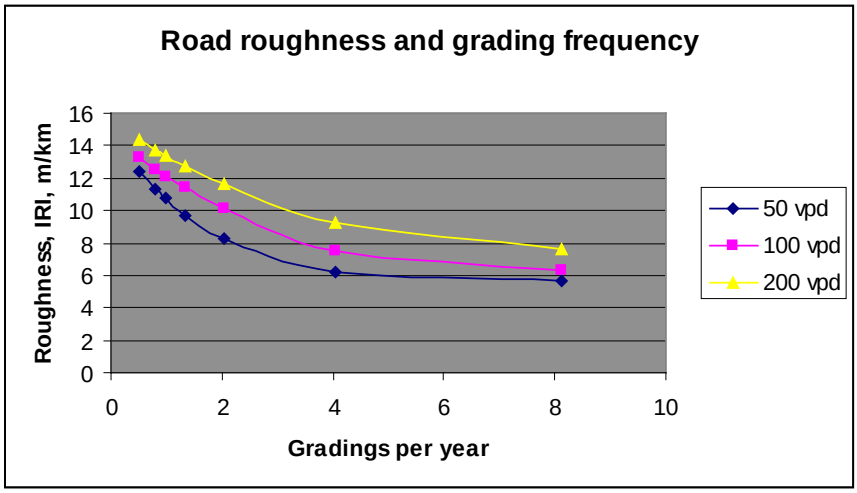
Most roads that are not all-weather or all-season have a weak point, or a location that is vulnerable to climate impact and hence will render the rest of the road unusable for through connectivity. The local road administration is usually aware of such weak points and may treat them as emergency maintenance events, but also often ignore them and accept that the road will be inaccessible for a period of time. A potential solution to increase accessibility at critical times would be to concentrate maintenance efforts on weak spots at relevant times of the year, in order to maximise the time that roads are open and encourage transport operators to provide year-round services. So year-round access can be an important factor in the development of transport services and we will explore this aspect during Phase 1.

4.4.6 Road condition

The condition of a road has a very significant effect on the type and nature of transport services. Vehicle operating costs are an important consideration for transport operators and will determine what type of vehicle they operate. For example, some roads may need four-wheel drive vehicles in order to negotiate poor areas and water crossings without structures. More regular maintenance of vehicles operating on roads in poor-condition is an obvious cost, as well as increased fuel use and increased journey times. These all combine to result in more expensive fares for such transport corridors. Road condition issues will be a major issue for transport services and its consideration will be an integral part of Phase 1 research.

Some road planning models are used to predict vehicle speeds and operating costs based on road condition and alignment. For LVRR, the Roads Economic Decision (RED) is often preferred over the Highway Development and Management (HDM-4) model, of which it is a derivative. While the assumptions of HDM-4 do not always make it suitable for the economic evaluation of LVRR (traffic volumes may not create sufficient VOC savings necessary to justify investments), the road deterioration relationships in HDM-4 are used by some road authorities for technical assessments. In HDM-4 and RED, road roughness is a key factor influencing vehicle operating costs. Road roughness can change, either by building a new running surface as, for example, when a bitumen surfaced road replaces a gravel road, or by frequent road maintenance. An example of the effects of different maintenance policies is shown in the graph below, which was derived from Ethiopian HDM-4 data. Here it can be seen that by increasing grading frequency on a gravel road, road roughness will fall, and in turn this will have an effect on vehicle operating costs. Hence it is essential to take into account the maintenance of the road when considering the viability of rural transport services provision.

Figure 1 Road roughness and grading frequency (derived from HDM-4)



Source: Ethiopian Roads Authority, 2002

4.4.7 Road geometry

Many parts of Africa have recently seen a rise in the number of motorcycle users. In Tanzania, consideration for motorcycles led to modification of road design manuals with respect to parallel concrete strips that can be dangerous for motorcycles. It does not seem clear whether current design practices in road carriageway geometry have taken sufficient regard of the large number of motorcycle trips on LVRR. It is often argued that if roads are made wide enough then road safety is enhanced. This is not necessarily the case since the interactions between the various vehicle classes, and between motorised and non-motorised vehicles, have a strong bearing on safety. There is an on-going debate about whether, or not, to provide wider sealed shoulders for low volume roads and decrease the lane widths for motor vehicles (Hongve and Pinard, 2016). The principle is that motorcycles and non-motorised vehicles would be better segregated from motor vehicles for safety reasons. Under Phase 1 of this project, we will search for studies that have investigated the impact of alterations of rural road width on rural transport services and their safety.

4.4.8 Road materials

A number of factors affect lifetime performance of low-volume roads. These factors include climate, hydrology, terrain, materials properties, drainage, subgrade, traffic, construction regime, and maintenance regime amongst other factors (Cook, Petts and Rolt, 2013). The performance of a road is largely governed by the ability of the pavement materials to withstand combinations of these factors. The quality of road materials significantly affects the performance of a pavement under varying climatic and traffic conditions. Specifications for materials for low volume roads have traditionally been based on international specifications, which are often inappropriate as they are based on a higher standard than is necessary. Many countries have recently revised, or are in the process of revising, their specifications to make them more appropriate for the local conditions and climate. If drainage is managed, then the performance of the road may not necessarily be compromised. The most effective way to keep the road structure dry is, of course, to seal it, but there are many options for environmentally optimised designs that provide a road that is fit for purpose at a reasonable cost.

Of the materials used in the various pavement layers, the surfacing layer materials have the greatest direct interaction with vehicles. Sealed roads are more durable and require less maintenance than unsealed roads. A more durable surface, if maintained properly, is likely to assist the development of transport services. However, the initial costs of sealing are often prohibitive and many roads remain unsealed.

Interactions between vehicles and the surface of erodible gravel or earth roads can lead to high road roughness. High road roughness leads to higher vehicle operating costs (VOC) e.g. damage to vehicle suspensions and increased fuel consumption. Consequently, transport services operators may find alternative routes to rough roads if these are more economically viable. There are also differences between the roughness acceptable to, and safe for, motorcycles and larger transport service vehicles. Under Phase 1

of this project, we will search for studies that relate road surface condition and transport of goods and passengers.

4.4.9 Structures and bridges

Bridges are a key component of a road. If a bridge fails, it can leave tens of kilometres of road inaccessible for long periods of time. If a public transport vehicle or commercial vehicle were to be stranded the wrong side of a bridge failure, it can cause major problems for the operator or owner. ReCAP are at present undertaking a project to design and trial modular bridges in Nepal. If Nepal is selected as one of the partner countries, there is a possibility to link with this project and monitor transport services on a road before and after the provision of a key structure. This would add valuable data to the understanding of decision making in establishing transport services. Similarly, in Tanzania, a bridge being constructed in Kilombero, under the President's Office, Regional Administration and Local Government (PO-RALG) with Improving Rural Access in Tanzania (IRAT) project funding, could provide case history material relating to changes in transport services along the connecting roads.

Other structures important to a road include culverts, retaining walls, causeways and river training. All of these have the potential to affect the way that transport operators view the risks in establishing transport services on a rural road.

4.4.10 Maintenance

Surveys of rural transport services in many African countries have suggested that the operators of rural transport services of various modes stress the vital importance of road maintenance to them (Starkey, 2007b). These opinions are also shared by the relevant road authorities. Appropriate and timely maintenance prevents escalating vehicle operating costs that inhibit good and affordable transport service provision. Additionally, appropriate maintenance leads to a longer life of the road asset, thus extending the time when the asset can act as a platform for transport services provision.

The ReCAP project 'Economic Growth through Effective Road Asset Management (GEM)' (GEN2018A) is underway and is relevant to this project. The purpose of the GEM project to achieve economic and social benefits for local communities as a result of improved performance in road asset management. We will review reports so far produced under this project and identify any synergies or learnings that are relevant to this project, whilst liaising closely with the project team. Any relevant issues will be incorporated into our Scoping Study Report.

4.4.11 Climate impact

The 'Climate Adaptation, Risk Management and Resilience Optimisation for Vulnerable Road Access in Africa' (GEN2014C) project is also relevant. It has the objective to build enduring capacity in AfCAP partner countries to deal with the threats and impacts of current and future climate on vulnerable rural access in a sustainable manner. This will include capacity at policy and practical level, particularly in those countries that are most vulnerable and where adaptive capacity is low. We will review the reports produced by this project and liaise with the project team, to learn of issues relevant to the provision-preservation-services continuum and our Scoping Study Report.

5 Key Tasks for Phase 1 Implementation

The main tasks of Phase 1 are overlapping, with an iterative progression involving consultations with colleagues and stakeholders, review of documents, planning the workshop and Phase 2 and 3 work, and reporting progress, with inclusion, feedback and renewed analysis integral to the processes. The key tasks will include:

- Task 1: Planning, Situation Analysis and Inception Report
- Task 2: Engage with stakeholders
- Task 3: Literature review, analysis and synthesis of lessons
- Task 4: Establish framework for Phases 2 and 3

- Task 5: First Inter-Regional stakeholder workshop
- Task 6: Phase 1 Scoping Report
- Task 7: Prepare peer-reviewed paper.

5.1 Situation analysis and conceptual framework

In the inception phase, we have started to develop a conceptual framework for the Phase 1 work, based on our existing understanding, but with scope for modifications based on new information. This will involve characterising the different forms of transport services (vehicles varying from buses, minibuses and trucks to intermediate means of transport, including motorcycles). Characteristics to be considered may include the type of operator, systems of ownership, types, ages and conditions of vehicles, finance mechanisms, hub-and-spoke systems (routes and point-to-point services), frequencies, reliabilities, seasonalities, fare and tariff structures and regulatory mechanisms (including planning, self-regulation and enforcement issues). The aim will be to have a framework that will allow systematic checking against key operational criteria when comparing datasets over time. The most valuable information is likely to come from data on how rural transport services have changed over time on specific roads. However, where such information is lacking, it may be possible to compare transport services on different roads, although ascribing cause and effect linkages to changes 'over space' will not be straightforward.

Similarly, the conceptual framework will characterise the various types of rural transport demand including passengers and freight, disaggregated by types of people (gender, age, occupations, disabilities, disadvantages, etc), purposes of transport, types of loads, volumes of loads, variation in demand by day and season. We will also consider factors 'external' to the transport supply and demand scenarios that can disrupt the 'normal' pattern over periods of weeks, months and years. These may include elections, civil unrest or war, severe weather events, changes in regulatory enforcement and disease outbreaks. The idea will be for team members to read publications, examine datasets, and talk to colleagues about changes in transport services, and try to link these (as reasonably as possible) to the changes in road infrastructure (improvements and deterioration), having considered other possible factors that may have influenced the changes. Due to the complexity of multiple influences affecting transport services over time, it may not be possible to ascribe definitive cause-and-effect linkages to single factors. However, with a good conceptual and analytical framework, it should be possible to highlight the key lessons concerning the interactions between road condition and transport services.

We will also conduct a situation and stakeholder analysis. We have started to identify and highlight relevant issues and some case histories in AfCAP and AsCAP countries. This is summarised in Section 6 and Annex 1 of this report, and will continue to be developed during Phase 1. We are also considering the colleagues and organisations that we will contact, mainly through emails and telecommunications. These will include AfCAP and AsCAP partner organisations, including road and transport research centres, rural road authorities and transport and road safety authorities. We will also identify bilateral and multilateral agencies with historical or on-going interest in rural roads and transport services. Examples include Asia Development Bank, the World Bank (including Sum4All and RAI teams), GIZ, SIDA, AFD, AfDB and DFID. The aim of contacts will be to obtain new information and ideas, but also to stimulate interest in potential participation in the forthcoming Phase 1 Inter-Regional workshop, and for potential collaboration in Phases 2 and 3. There is an on-going dialogue with the ReCAP PMU in relation to important and influential sources of information and contacts.

5.2 Conceptual framework

To carry out an analysis of the effects of changes in road infrastructure condition on transport services, it is desirable to have a wide range of data available relating to the infrastructure, the transport services and other relevant factors affecting transport demand and traffic on the roads being studied. Some of the categories of desirable information are provided in Tables 1-3. These illustrate potentially-valuable analytical parameters, although it is recognised that that such comprehensive datasets seldom, if ever, exist for LVRR.

Basic data on infrastructure condition, before and after intervention is required, together with before and after transport services and traffic data. Table 1 lists key LVRR infrastructure information that will be required (or desirable). Where possible it would be useful to collect information on any changes in adjacent and surrounding road infrastructure to account for traffic diversions.

To understand how transport services respond to changes in LVRR, it will be desirable to have good data on various transport services parameters and indicators. Some of the types of data that are useful for understanding rural transport services are shown in Table 2. Some of these indicators are from the AfCAP-funded Rural Transport Services Indicator Project (Starkey et al, 2013). This project developed a rapid appraisal methodology that allows researchers to quickly obtain small, but very relevant, datasets that can highlight issues requiring more detailed data collection. However, there are very few comprehensive LVRR transport services datasets available. Most LVRR projects have simply used traffic counts as a proxy for transport services. With an understanding of the prevailing traffic and transport services situations, it is possible to extrapolate some transport services information from traffic counts. However, for a good understanding of the changes to transport services over time, traffic counts have to be supplemented by more detailed transport services surveys, with appropriate sample sizes. Such surveys, focussed on the impact of LVRR investments on transport services, will almost certainly form part of the Phase 2 research.

There is a wide range of external factors that will influence the composition and growth of traffic and transport services. Despite changes in LVRR due to investment (or neglect), transport demand and transport services may be even more affected by factors that have nothing to do with that particular road, and its condition. Table 3 identifies some of the key external factors. These include data on sector trends (i.e. traffic growth rates) as well as regulatory changes and local industrial and agricultural developments.

The three tables presented here constitute a ‘wish list’ and in practice it may not be possible to collect all the identified data requirements. It is understood that detailed transport services data linked to road investment data is very rare. It is possible that some indicative estimates of impact may be identified through using the ‘double-difference’ post-evaluation technique. With this methodology, comparisons are made of transport services data relating to ‘before’ and to ‘after’ road investment (one difference) and for both ‘project’ roads (with investments) and ‘control’ roads (without road investments, the second difference). In any case, it should also be recognised that the above tables are a ‘work in progress’ and that more information and clearer indicators and parameters may be added as the research develops.

Table 1 Examples of infrastructure-related information required or desirable

Criteria	Information required or desirable
Date and source of information	Include key dates for recent and past interventions
Location	Country, Region, District, Road name, GPS coordinates
Terrain	e.g. flood plain, flat, rolling, hilly, mountainous
Infrastructure classification and type	e.g. feeder / district road, vehicle track, earth / gravel road, stone surface, bituminous / concrete road, motorcycle trail, pedestrian path
Assumed purpose of the road	e.g. to increase access to markets and services for the rural population, and/or access for agricultural, forestry, mining or commercial enterprises
Key features	e.g. very steep gradient, seasonal flooding, missing bridge
Infrastructure Function	A rural road, linking local villages to local town or the road network; a secondary road taking a mixture of local and regional traffic
Road parameters	Length, width, vehicle lanes, design standard, drainage types
Structures	List key structures present and absent
Earlier and latest condition	e.g. roughness data, or poor, medium, good surface, etc
Current and previous passability	e.g. all year vehicle passability is possible; four wheeled vehicles cannot pass for three months in rainy season; most vehicles cannot pass for a week during rainy season; only pedestrians or motorcycles can pass
Maintenance practice	e.g. emergency, routine, grading, resurfacing, etc
Description of infrastructure changes	e.g. road rehabilitation, a new bridge was built, road upgrading through paving, a new gravel road was constructed
Main sources of transport demand and traffic origin	e.g. linking communities to markets, nearby towns, mines, forestry, large scale commercial agriculture, linking with regional capital, long distance traffic using roads, etc
Possibilities for traffic diversion and external transport infrastructure	e.g. Not possible as no nearby alternative routes, Diversion is possible because of dense network, An alternative route was upgraded and diversion away from this road was likely, An alternative route fell into disrepair and so traffic has diverted to this road

Table 2 Examples of before and after traffic and transport-services-related data required or desirable
Note: where appropriate, data to be disaggregated for vehicle type and user gender

Criteria	Information required or desirable
Traffic volumes and composition	Traffic data should be disaggregated for different types of motorised transport. Depending on local vehicle types these should include motorcycles, three-wheelers, 2-wheel tractors, cars, pickups, Jeep/4x4s, minibuses, midi-buses, buses, light, medium and heavy trucks and 4-wheel tractors
Traffic volumes and composition	The data collected should include non-motorised transport including pedestrians, bicycles, tricycles and animal-powered transport
Traffic volumes and composition	Where possible, traffic data should be disaggregated by vehicle function (especially private use/transport services), loading level, gender (operators and passengers) and origin/destination.
Factors affecting traffic count volumes on specific days	Season and weather, market days, important local events (wedding, funeral, sports fixture, religious festival), school holidays, national holidays, elections, strikes, demonstrations, disease outbreaks, etc
Vehicle Operating Cost Components	Key components such as: vehicle purchase prices; vehicle age; fuel, lubricants, tyres and maintenance costs; crew costs; insurance; road taxes; association and terminal fees; bribes and barrier fees.
Freight Charges	Charges expressed per tonne/km
Fares for using RTS	Fares expressed per passenger/km
Availability of service	Number of travel opportunities per day
Predictability of service	Availability of timetable (formal/informal)
Waiting time for services	Roadside/terminal waiting time for users
Space on service	User perception of likelihood to get onto the first available service
Travel speed of service	Average time taken to travel between two locations
Disruption of services	Differences in travel time and waiting time due to seasonal service disruption
Safety, security and comfort of service	User perception of accident risk, security risk, comfort, crowding and travel conditions (heat, noise, etc).
Access for older persons and people with disability	Convenient access to transport services for older persons and people with disability; application of 'universal design' in rural transport services and related infrastructure
Small freight transport by service	e.g. cost of 20-50 kg of accompanied goods
Medium freight transport by service	e.g. cost of 200 kg of unaccompanied goods
Mobile phones and RTS	User ability to use mobile phones to access services and/or obtain information regarding service
Facilities at terminals and roadside stops	Existence/satisfaction with 'bus shelters' and facilities at roadside stops
Courier facilities	Existence of/satisfaction with courier services provided by transport operators
Market trends	Trends in passenger and freight volumes and numbers of transport services vehicles in operation

Source: After Starkey et al, 2013

Table 3 Some external and regulatory factors affecting traffic volumes and transport services

External and regulatory factors	Information to consider
National trends in population and/or urbanisation	Useful background to transport demand
National trends in Gross Domestic Product (GDP)	Useful background to transport demand
Economic factors including inflation and availability of credit and foreign exchange	Factors affecting ability to purchase transport services vehicles (including investments of urban operators who may supply second-hand vehicles for rural operators)
Recent factors affecting incomes, agricultural output, and/or population movements	Factors such as droughts, diseases such as Ebola, or civil unrest, or civil war in neighbouring countries, can be important influences
National trends on vehicle types, availability and registrations	Growth rates of different vehicle types (including motorcycles and electric vehicles), registrations and traffic volumes, including changes relating to import and use of old vehicles
Operation of regulatory barriers	Addition or removal of barriers for police, customs, forestry, axle load, etc, and changes in the 'barrier fees' extorted (where relevant)
Operation of formal transport services	New routes or fares of formal bus services
Operation of agricultural marketing boards, agricultural processing, timber concessions	New procedures for the marketing depots and/or collection of large scale agricultural commodities
New industrial developments	The opening of a new cement factory, quarry, petroleum distribution centre or artisanal mining
Changes in rural and urban markets	Significant urban market development can stimulate the growth of rural 'feeder' markets
Legal and regulatory framework of vehicles and relevant changes in enforcement on national roads and LVRR	Legality of motorcycle taxis and enforcement issues
	Legality of use of three wheelers and enforcement
	Controls in passenger fares and tariffs and enforcement
	Controls in authorised vehicle types and routes and enforcement
	Changes in safety criteria and enforcement
	Changes in vehicle loading/enforcement
	Changes in axle load controls and enforcement
	Changes in vehicle insurance and enforcement
	Changes in regulation of heavy vehicles using specific routes and enforcement
Operation of transport associations and unions	Changes in fees, membership and controls
	Introduction or removal of bus, truck or motorcycle association parks

5.3 Criteria for selecting the countries for Phase 2

In order to undertake a proper analysis of the interaction of transport services and infrastructure investments, it is desirable to have a 'full cycle' of information, covering the pre-investment (or neglect) situation and the post-investment (or neglect) situation. There should be a good description of the engineering interventions and maintenance policy, including the planning rationale for the investments. There needs to be transport services information, or at very least good traffic data. Ideally, the transport services (and traffic) data should already include 'before' and 'after' intervention datasets. It is possible to obtain correlations between personal mobility patterns and recent road investments (Bryceson, et al, 2008). However, the intention of this research is to gain evidence and understanding about transport services responding to changes in LVRR condition, and this makes it particularly important to try to obtain

time-separated, but comparable, road-specific datasets. If possible, the transport services data should include details of tariffs, loading levels and frequencies of the different types of public transport. Also, it is preferable to have some data for comparable roads without investment (or neglect), to act as controls, and illustrate changes in transport services due to external factors. If good datasets can be identified, then we will be able to analyse them during Phase 1 (the Kenya Roads 2000 example is one dataset we can study). During Phase 1, we will select suitable case histories for further investigation during Phase 2. This Phase 2 research will allow us to gain more details on transport services changes, to complement the existing data and allow a 'full cycle' of information to assist our analyses and understanding.

Phase 2 will include fieldwork in one or two AfCAP countries and one or two AsCAP countries. We will develop the research framework and criteria for country selection during the current phase, but we can highlight (and share) the key requirements. These are:

- Existing datasets, preferably covering several years including transport services information (or well-disaggregated traffic data) spanning a period of specific LVRR investments (or neglect).
- Potential partner organisations in the country with strong interest in investigating the transport services issues relating to LVRR.

If there are several countries with both good datasets and partner interest in this research, we will examine the various options and make selections based on:

- The quality of the existing data and the potential to complement it with new good data
- Obtaining an overall research balance that provides a range of investment situations (engineering, topography, ecosystems) and a diversity of transport services modes.

The time available in Phase 2 will allow the team, working with the in-country partner organisation, to arrange for the collection of additional transport services and engineering data on the selected LVRRs. This information will complement existing datasets (the presence of which will be a requirement for Phase 2 research sites). The Phase 2 schedule will not allow a 'full-cycle' of data to be obtained, but if good 'before' data already exists, then our Phase 2 research will present an opportunity to collect 'after' transport services information, following specific LVRR interventions. For example, the IRAT road programme in Tanzania might present an opportunity relating to recent investments in a new road and bridge on the Chita-Merera road in the Kilombero valley. There exist several years of 'before' traffic data collected in both wet and dry seasons. Therefore, if the road and bridge are completed in 2018, new 'after' surveys relating to transport services provision could be carried out on both project and control roads. However, as it may take several years for transport services to develop in response to investments, a longer data-collection period might provide greater understanding.

5.4 Engage with stakeholders

We have started to conduct a stakeholder analysis to identify the many colleagues and organisations that we will contact during Phase 1. Communications with key stakeholders have begun during the inception phase and will continue through a systematic, rather than linear process.

In consultation with the PMU, a project flier was prepared. Based on this, a brief item was contained in the May 2018 ReCAP newsletter soliciting contacts and case history examples. This is also available on the ReCAP website on the 'Blogs' page. We are aware that the PMU has discussed potential interest in this project during recent AfCAP and AsCAP meetings. We ourselves anticipate contacting a large number of AfCAP and AsCAP colleagues as well as related resource organisations (including road and transport research centres) and the donor community. We will initially contact people through electronic media, and we expect that the conversations that develop will result in the identification of additional contacts suggested as being interested in our research areas.

With the time and resources available to team members, we do not envisage specific international journeys to meet people in Phase 1, but all team members are engaged with other transport projects and will be travelling to several different countries in Africa and Asia. The team members will be interacting with AfCAP, AsCAP and other colleagues as part of their other duties, as well as the service providers of several

key AfCAP/AsCAP projects. For example, during the Inception Phase, all team members met various AfCAP colleagues while working in Ghana, Liberia and Tanzania. Team members also envisage being in personal contact with various colleagues in the ADB, World Bank, GIZ, SIDA, DFID and other agencies. They will also make electronic introductions to relevant stakeholders with whom they are not in contact.

We have also been in touch with the PMU to ask about other events and workshops that could help us to engage with stakeholders and for additional suggestions for important and influential contacts.

5.5 Literature review and some implications for Phases 1 and 2

Team members already have access to numerous relevant publications and several important datasets. Relevant publications include the many assembled for the poverty and transport study (Starkey and Hine, 2014) and the rural road network and poverty study (Hine, et al, 2016a). We have also started to systematically search for new information, through keyword searches of the academic literature, web-based searches and interactions with discussions with colleagues around the world. Contacts with colleagues in AfCAP and AsCAP countries will be particularly important in obtaining additional unpublished data and 'grey literature' which may help inform the literature review, data analysis and the subsequent choice of suitable research sites for Phase 2. We will benefit from existing literature reviews undertaken by other researchers, including those of the AfCAP GEN2109A First Mile Project and the AfCAP RAF2114A Safe motorcycle and three-wheeler use project (Bishop, et al, 2018).

We have started to assemble and analyse case history examples of changes in road condition that have resulted in positive, negative or neutral/surprising changes in transport services. The 'conventional' transport sector models suggest that improving the quality of a road will lead to greater and cheaper transport services, with modal shifts from older, smaller vehicles and intermediate means of transport (including motorcycles) to newer, larger-capacity vehicles (minibuses, midi-buses, buses and bigger trucks). The combination of less wear and tear (lower operating costs) and higher capacities (economies of scale) should lead to lower fares and tariffs. As economic demand picks up, one would expect higher frequencies of transport services as well. As a road deteriorates, the process can be reversed, with increased use of older, smaller vehicles and increase in tariffs. We already have examples of such scenarios and are confident of obtaining others. The timescale for changes (positive and negative) is likely to vary with the overall economic activity, population in the transport catchment area and the transport demand, and we will look for evidence of this. With low economic demand, improvements due to good roads may be surprisingly slow (as has been reported), but deterioration due to poor maintenance may be quite rapid.

However, there will be other examples where significant improvements in LVRR conditions have not resulted in major changes to transport services. It will be particularly interesting to investigate these and learn the lessons. One example of this was reported from Hintalo Wajirat, in Tigray, Ethiopia. A good quality gravel road connecting villages failed to stimulate regular transport services on non-market days. This appeared to be because the new road catered mainly for a within-wereda (district) hub and spoke system with low transport demand. The main economic transport demand in the area related to movements to-and-from the transport and market hub of the regional capital of Mekelle, and not for cross-country journeys within the wereda (Starkey, 2007a).

During the research it may be possible to gain further data and insights into such examples. To take another example, a recent AfCAP transport services diagnostic study in Ghana (GHA2050A) noted that a low-volume, 15 km asphalt road between Hatorgodo village and Abor (on the national highway in southeast Ghana) had no regular minibus services, and motorcycle taxis were still the main means of transport on this road, several years after the upgrade (Afukaar, et al, 2017a). It may be possible to obtain more evidence relating to the transport services situation and the various planning and evaluation processes relating to the road upgrade. This could be considered as a possible study for Phase 2 (although such decisions will only be taken when there are more examples to choose from). The same ReCAP study noted that in the northwest of Ghana, the minibus and taxi transport services between Wechiau and Wa opted for a poorer road with high transport demand rather than a better road that had been prioritised for maintenance by the road authority, but which passed fewer villages (Afukaar, et al, 2017b). An understanding of the

decision-making processes relating to these examples could feed into the lessons relating to the provision-preservation-services continuum.

Although there is substantial literature on the impact of rural road investment incomes and agricultural output, surprisingly less information is available on the rates of travel, traffic volumes and traffic composition. A recent Systematic Review of the impact of rural roads (Hine, et al, 2016) found six studies, published from 1996 to 2010, that were able to quantify the effect of road improvements. The results indicate a substantial variation in effect (see Table 4). Very high traffic increases (312% over six years) were recorded in Nicaragua (Goss Gilroy and Orbicon, 2010) and much lower increases in Indonesia, Sri Lanka and the Philippines (Hettige, 2006). One reason for large changes in traffic volumes in Kenya (Ahmed, 2010) was reportedly due to the effects of diversion from poorly maintained roads. In this example, there were both substantial traffic increases on newly completed project roads as well as substantial traffic decreases on the control roads. Obviously, this effect will vary considerably from place to place; where the rural road network is not densely interconnected local diversions will be limited or non-existent.

Traffic declines on roads that had not been improved and were in the same area as roads that were improved, were also identified in Nigeria by Porter (1997). It can be anticipated that initial improvements in rural transport services following road investments may diminish as the road condition deteriorates, with the rate of change depending on a range of factors. While many studies relating to road investments have used traffic data, some studies have looked at the 'outcomes' of the investment, including people's mobility. Surveys in Ethiopia, Zambia and Vietnam showed increases in personal mobility associated with road investments, without similar changes in the 'control' areas that had not had recent road investment (Bryceson et al, 2008).

Table 4 The effect of rural road investment on traffic volumes

Country	Study	Changes in traffic volumes, and overall trip making
Nicaragua	Goss Gilroy and Orbicon (2010)	Between 2002 and 2008 motorised traffic volumes increased by 312% for projects in the Las Segovias area. Although no traffic data was collected for comparison communities, qualitative fieldwork found no indication of increased traffic for the comparisons.
Kenya	Ahmed (2010)	Between 2007 and 2009, there was an increase of 157% in passenger movements and an increase of 42% in motorised freight. In comparison, there were declines of 32% for passengers and 84% for freight on control roads. Traffic diversion from poorly maintained roads was believed to be a major factor.
Kenya	Airey and Cundill (1998)	In the project area, travel rates increased from 5 journeys per month per household in 1983 to 11.2 journeys in 1986 (after the road investment). However, they later declined to 8.4 journeys in 1989.
Morocco	Levy et al. (1996)	There was an average traffic growth of 13% per year for project roads compared with a national trend of under 8%. With improved roads there was no road closure; previously the three project roads had been closed for 90 days, 60 days and for the rainy season respectively.
Indonesia, Sri Lanka, Philippines	Hettige (2006)	For out-of-village travel, on average, 12 person trips per month were recorded for project sites compared with 9.9 for control sites.

Source: Hine et.al, 2016a.

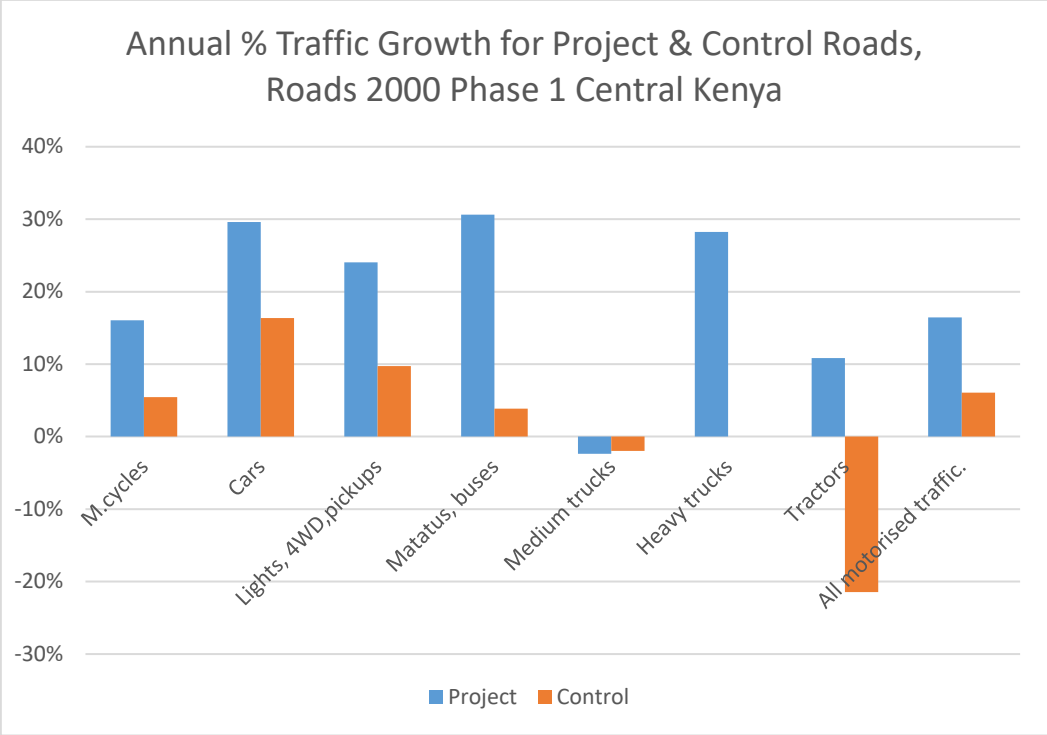
In the same systematic review, nine studies reported changes in transport costs, fares and tariffs following road investment (Hine, et al. 2016a). The largest difference in tariffs was the 31-fold ratio in costs (per tonne/km) between head loading and transporting by truck. The range in changes in tariffs for improving existing accessible roads varied from a 50% reduction in one case to no change in another case, with the lack of response put down to a lack of competition. Marked seasonal changes in transport tariffs were noted for unpaved roads, where tariffs were found to be up to 60% more in the wet season.

We have access to a range of more up-to-date 'before and after' traffic data from the IRAT rural road 'bottleneck' improvement programme in Tanzania and the Roads 2000 programme in Kenya. Both of these

datasets would be suitable for analysis under the project. In Tanzania, IRAT surveys covered five rounds of traffic counts over three years (2015, 2016, 2017) on up to 28 roads, including wet and dry season counts on project and control roads. Using this data from Tanzania, it would be possible to make before and after comparisons (with control observations) on ten roads that had major "bottleneck" interventions including new bridges and culverts and embankments (Cardno, 2017).

In Kenya two rounds of survey data were collected on eight project roads and four control roads for the ex-post evaluation of the Roads 2000 project of the Government of Kenya (GoK) supported by the Agence Française de Développement (AFD). The 'before' studies were in 2010 and 2012 and the 'after' studies were in 2016. In this case the road interventions covered both new gravel roads and new paved roads. The Kenyan road study also found significant reductions in fare levels, and a substantial growth in traffic volumes, compared with control road data (Hine and Bradbury, 2016).

Figure 2 Traffic growth over four years on Project 2000 Roads and control roads in Central Kenya



Source: Hine and Bradbury, 2016

Other data from Ethiopia might be used to explore the average effects of road improvements on main and secondary roads. The analysis was based on national traffic surveys using data for 25 road sections with improvements compared with 97 sections where no improvement took place. In this case, generated traffic was calculated by subtracting the traffic growth on roads where no interventions took place from the traffic growth on the improved roads. In this example, it was found that for the average road improvement, buses had higher generated traffic (18%) than other vehicle classes. Cars were observed to have 10% and rigid trucks 14% generated traffic following road improvements, while articulated trucks were found to have the lowest amount of generated traffic at 4% (Ethiopian Roads Authority, 2005).

A range of other data is available that can help with the investigation. For example, data from studies in Ethiopia relating to the Universal Rural Road Access Program (URRAP) have been collected for 77 roads for 2015, 2016 and 2017. It was found that motorcycle traffic increased by over 242% between 2015 and 2016, it then declined by 32%. While overall traffic volumes increased by 88% between 2016 and 2015, it then declined by 40%. The most likely explanation for this unusual pattern of behaviour is the nationwide drought (Ethiopian Roads Authority, 2017).

Other sources of information might include:

- Data collected under the ReCAP "Back Analysis" project (RAF2069A). Here present and past traffic data together with engineering interventions and road condition data are being entered into a database for the assessment of the long-term road deterioration of different engineering designs.
- Post evaluation studies available from the World Bank and other Multilateral Development Banks.

5.6 Establish framework for Phases 2 and 3

The team already has access to various relevant issues and datasets in several AsCAP and AfCAP countries, but does not wish to prejudice the Phase 1 open-ended research and the Phase 1 selection of countries and research methodologies. Therefore, any examples provided here are purely illustrative of the types of situations and research possibilities that will result from Phase 1.

We will, through the literature and inputs from stakeholders, identify countries and locations where there is potential to gain valuable data that, with previously captured data, could yield valuable lessons. The research time available in Phase 2 will mean that the team will not be able to address the research questions, unless there are already valuable datasets available. While some interesting research could be conducted using surveys of the 'memories' of rural stakeholders and transport institutions, research at this level and importance will need to be based on reliable existing datasets, with which newly-acquired data can be compared. If these datasets are incomplete, local and institutional memory can be surveyed, but this should be to add to already-existing data.

Following a review of the literature, assessments of available data sources and inputs from the stakeholder contacts, a design framework will be prepared for Phases 2 and 3. The framework will be based on a combined assessment of knowledge gaps, profitable research opportunities to explore, and the likelihood of good cooperation from ReCAP partner institutions. The main purpose of the work will be to strengthen our understanding of the relationships between infrastructure and transport outcomes (e.g. traffic volumes, modal composition, transport fares and charges, accident rates). A better understanding of how transport outcomes are affected by different engineering solutions should, in turn, improve our understanding of how road investment will improve the livelihoods of the rural population.

Information on the final impact of rural road investments (e.g. income levels and poverty reduction) has been the subject of many studies, and recently reported in a Systematic Review (Hine, et al, 2016a). However, it was identified that a major deficiency of the overwhelming majority of impact studies was that they did not adequately address how changes in accessibility and engineering standards directly affected transport outcomes and the follow-on impact. Rather, rural road improvements were treated as uniform interventions to be related straight to final impact, largely ignoring the intermediate mechanisms by which engineering changes affect transport outcomes and, in turn, influence impact.

It is envisaged that fieldwork will be undertaken in post-construction locations where earlier pre-construction data on traffic volumes, fare levels and modal composition has already been collected. Where possible 'control' data will also be collected in order to balance out secular trends (for example natural traffic growth and the underlying growth of motorcycles) and thus more clearly identify the direct effect of road investment and change in road condition on transport services. In view of the timescales involved, a double difference approach will not be viable for the Phase 2 work, as it is unlikely that both pre- and post-construction data can be collected within the time available.

In order to collect information on the benefits and dis-benefits for poor and low income communities of road construction, data will be collected from traffic surveys, surveys of fare levels and transport operators. In addition, Focus Group discussions and key informant interviews will be undertaken. Through triangulation techniques, changes in a variety of factors will be explored covering issues such as the availability and price of transport services, attendance at schools and health centres, road accidents, commodity prices, employment, crop sales, etc. However, at this stage it is not envisaged that extensive household surveys will be undertaken.

A detailed assessment of how road construction, road maintenance and road condition affect rural transport services should also, in turn, improve the planning of different types of engineering interventions. With better relationships, road planning and management models may also be improved and achieve

greater predictability. As noted previously, both RED and HDM-4 are used to model the performance of LVRR. RONET (Road Network Evaluation Tools) is also used for network-level planning purposes.

As part of Phase 2, the adequacy of transport services will be assessed in each location and the various constraints identified. This will be undertaken via operator surveys and key informant interviews. It is quite possible that the Rural Transport Services Indicator (RTSi) appraisal methods will be used to learn from four different types of rural stakeholder: transport users and non-users (disaggregated by gender, age, occupation, disability and other socio-economic factors), passenger and freight transport operators (disaggregated by the different transport modes and types of operation), local transport regulators and enforcers, and relevant people concerned with rural socio-economic development (e.g. staff of clinics, schools and NGOs). Key informants would also include local governments and traditional leaders. The RTSi has been designed specifically to allow rapid assessments of transport services issues, using small sample sizes of a range of different stakeholders. However, the stakeholder sampling techniques can be adapted to allow in-depth evidence to be collected.

Key transport services issues that will need to be considered in Phases 2 and 3 may include:

- the adequacy of the wider road network
- the overall density of demand
- the regulatory framework
- the institutional framework including operator cartels.

These issues will be considered in greater detail in Phase 3. In order to ensure an adequate pattern of transport services (particularly in areas of low density of demand) different possible solutions will be explored. These include public-private partnerships, including measures such as 'bidding for the market', that are commonly employed in higher income countries, together with operator subsidies. These issues have been discussed recently, with various options for facilitating transport services provision, in Hine, et al (2016b).

5.7 First inter-regional stakeholder workshop

The first inter-regional stakeholder workshop should be a very valuable opportunity to share and discuss the Draft Scoping Report containing our initial findings, including the results of our literature review, our initial interactions with AfCAP, AsCAP and other stakeholders and our draft framework for Phases 2 and 3. The selection of the host country (in consultation with the ReCAP PMU) will depend on technical and logistical criteria, including linkages with other events, travel convenience and access to suitable field visit locations relevant to LVRR provision-preservation-access interactions.

There have been consultations with the PMU relating to the practicalities of this workshop and its timing. At the time of writing, these discussions are on-going, and so the subsequent paragraphs are merely an indication of some of the issues that are being discussed and addressed.

In consultation with the PMU, it was agreed that there did not appear to be any suitable international transport workshops onto which the first regional stakeholder workshop could be conveniently 'piggybacked'. However, there could be synergy if the workshop was to be held in collaboration with regional or national workshops associated with the AfCAP First Mile project (GEN2109A) and/or the AfCAP Safe motorcycle and three-wheeler use project (RAF2114A). Unfortunately, the RAF2114A motorcycle project does not have a regional workshop scheduled soon, but the First Mile project is due to hold workshops in Kenya and Tanzania in August and September 2018.

In the GEN2136A ToR, the first workshop was scheduled for Month 3.5 (mid-August 2018), on the basis that the Draft Scoping Report is due at the end of Month 3, and the Workshop Report is due at the end of Month 4. In discussion with the PMU, it appears more likely that the workshop will be held in mid-to-late September (or other mutually-agreed time). Shifting this date will provide more time for the technical review and circulation of the Scoping Report. It will also allow for possible synergy with a workshop of the GEN2109A First Mile project. It may also be possible to invite national and/or international representation from the RAF2114A motorcycle project.

Having discussed possible locations with the PMU, we will investigate options for our Phase 1 workshop to be held in Kenya, probably between mid-September and mid-October 2018, depending on planning and logistical considerations and other factors. Kenya has good international flight connections, suitable visa facilities for most AfCAP and AsCAP participants, accessible LVRR examples with transport services and valuable road-rehabilitation transport services datasets (under the Roads 2000 programme). Kenya is also one of the two GEN2109A First Mile countries and is participating in the RAF2114A motorcycle project.

The workshop will include presentations and discussions of the Draft Scoping Report prepared by the team from the literature review. If practicable, workshop participants will visit LVRRs in small groups to view examples of rural roads and transport services, and discuss with local stakeholders the access-transport services issues. All participants should benefit from such roadside discussions, but this will be particularly important for the road engineers, who may be unfamiliar with the perspectives of transport services operators. This field visit will be undertaken before the presentation and discussion of the proposed framework for Phases 2 and 3. This will ensure some joint knowledge and understanding of the local situation to inform the subsequent discussions. Facilitated small group discussions are likely to be used to focus discussions and identify the key lessons and their practical and policy implications.

The duration of the workshop will depend on both technical and logistical criteria, and the envisaged programme will be decided in consultation with the ReCAP PMU. As most people are likely to be travelling specifically for this workshop, then 2.5 or 3 days may be appropriate, to allow presentations, field visits and detailed discussions. If the workshop is linked to the First Mile workshop, the programme covering both projects is likely to be 4 days.

During the coming weeks, these issues will be discussed (in coordination with ReCAP PMU), to ensure timely workshop announcements and notifications with sufficient time for preparations.

We will endeavour to invite one or two suitable participants per AfCAP/AsCAP country. Where practicable and appropriate, we will try to invite one LVRR person and one Transport Services person per country, and anticipate a workshop of about 35 participants, comprising the project team, national stakeholders, ReCAP representatives and donor-agency transport professionals.

5.8 Reports and peer-reviewed paper

Following the submission of the Inception Report, the next scheduled output is the Draft Scoping Report, containing the literature review, contacts with stakeholders and analyses. This is due at the end of Month 3 (end July 2018). This will report progress and provide initial recommendations on how the continuum of access provision, maintenance and transport services can be improved to enable better rural mobility and access to markets, health facilities and services. It will also contain initial ideas and suggestions / options for the Phases 2 and 3 research. With ReCAP PMU approval, this will be circulated to stakeholders before the inter-regional workshop. It will be a key resource for this workshop, and further ideas, suggestions and feedback will be sought from workshop participants.

Following this report, we will produce an Inter-Regional Workshop Report and we will revise the Scoping Report to take account of the ideas and recommendations of the workshop. This version of the Scoping Report will contain our framework and recommendations for Phases 2 and 3, for consideration by the ReCAP PMU. Finally, we will distil key elements of the literature review, analysis and findings into a paper suitable for an international peer-reviewed journal with open access. In Section 7 of this report we discuss the timing of these outputs.

6 Situation Analysis Relating to AfCAP and AsCAP Countries

6.1 Relevant information from AfCAP and AsCAP countries

As part of our situation analysis, we have compiled some country-specific information relevant to LVRR and some pertinent provision-preservation-access issues of which we have become aware, including some relevant national institutions and supporting donor agencies. This is provided in Annex 1.

The information from Annex 1 is summarised in Table 5, which shows our initial impressions on the likelihood of obtaining relevant datasets and possible partner organisations in the rural road sector in both Africa and Asia. At this stage this analysis is based on a search of available information and is not the result of direct consultations with roads agencies or government departments themselves. The next step is to consult directly with countries in order to select up to two countries that have accurate and relevant data that could be used for this research.

6.2 Transport services stakeholders

The country level information provided in Annex 1 and Table 5 focuses on infrastructure, rather than transport services. However, all the countries cited have a ministry responsible for transport services, and some countries have a designated regulatory and planning authority. It is envisaged that these organisations will be points of contact and may offer insights to understanding the interactions between transport services issues and infrastructure provision. However, it is understood that, due to resourcing issues, the ministries and authorities responsible for transport services have little presence (or understanding) when it comes to LVRR (Starkey, 2017). As this project develops, we will try to engage and involve transport services authorities. At the same time, we will encourage roads-related organisations to become aware of, and involved in, transport services issues.

While most rural transport services operators are within the informal private sector, in some countries there are very influential transport associations, some of which work at a national level. Such associations can operate as national coordinating bodies, restrictive cartels or rent-seeking 'membership' schemes. In most cases, the associations are focussed on urban and inter-urban issues, but we will try to engage with associations concerned with transport services on LVRR as far as is practicable.

Table 5 Summary of potential sources and partner countries

AFRICA			
Country	**Road network status**	**Likelihood of good data sources**	**Potential partner**
DRC	Low all-weather network, large land area but few roads	Possible	To be advised
Ethiopia	High recent investment in roads, increased rural network, much of which is unpaved	Probable	ERA
Ghana	Well developed network, good knowledge exists, minibus transport popular to rural areas	Probable	MRH/Feeder Roads
Kenya	Well developed network, good knowledge exists, many unclassified roads many of which are rural	Known data (GoK/AFD)	KeRRA/MTRD
Liberia	Less well developed rural network, motorcycle taxis prevalent	Possible	To be advised
Malawi	High transportation costs, recent focus on backlog maintenance	Possible	To be advised
Mozambique	Network being re-established following conflict, road building materials scarce	Possible	ANE
Sierra Leone	Less well developed rural network, with few paved roads, modest transport demand	Possible	To be advised
South Sudan	Minimal network, very few paved roads, affected by conflict	Unlikely	To be advised
Tanzania	Reasonable knowledge of network, data sources available	Known data (AfCAP 1) IRAT	TARURA
Uganda	Good knowledge of network, including rural areas, data sources available	Probable	UNRA
Zambia	Road network established, inventory needs updating in rural areas	Probable	RDA/RDU
ASIA			
Country	**Road network status**	**Likelihood of data sources**	
Afghanistan	Limited network following years of conflict, low vehilce ownership	Unlikely	To be advised
Bangladesh	Large rural network, good inventory and knowledge, high traffic volumes and varied transport modes	Probable	To be advised
Myanmar	Low connectivity, low demand, majority of roads unpaved	Unlikely	To be advised
Nepal	Reasonable knowledge of network, significant donor inputs	Known data (RAP/DRSP)	DoLIDAR
Pakistan	Large rural network, high sustained growth in network	Possible	To be advised

7 Risks Analysis and Comments on ToR

7.1 Risk analysis

The risks and assumptions for delivering the project largely remain the same as those outlined in our technical proposal.

- There is an initial risk in the selection of participating countries that expectations will be raised by asking countries for information that will lead to their selection. Ultimately we can only select up to four countries, but we need to gather information from all in order to make that decision. We intend to liaise closely with ReCAP PMU on this issue to avoid unrealistic expectations of participation.
- There is a risk that by the end of Phase 1 we would not be able to identify suitable countries for Phase 2 that have appropriate projects and relevant data. We are however aware of at least four ReCAP countries with probable suitable research data for Phase 2, so we therefore regard this risk as minimal.
- Another risk in Phase 1 is a possible lack of motivation of AfCAP and AsCAP road sector stakeholders to actively engage with this project in terms of document provision, research site selection and participation in the workshops. In mitigation we propose that with assistance from ReCAP and through our existing, long-standing relationships with stakeholders in Asia and Africa, we will be able to stimulate active participation.
- There is a risk that no agreement is reached on a way forward for the project at the end of Phase 2. This is considered as unlikely and is therefore also regarded as a low risk.
- Of the three phases of the project, Phase 2 is the most susceptible to risks. Possible risks include delay in data collection or provision, especially where undertaken by local stakeholders; and unexpected in-country events influencing the research.
- There is a risk that the project will not be delivered on time and to budget. Continuous monitoring will minimise this risk and potential problems will be highlighted to ReCAP as early as possible so that alternative solutions can be put in place.
- There may be constraints related to production of technical papers for a peer reviewed journal and international conferences. It is expected that such constraints can be overcome at the time through liaison with the organisers.

7.2 Further comments on the ToR

If the date of the workshop is delayed in consultation with the PMU, it may be necessary to extend the duration of Phase 1 slightly. If this is necessary, we believe that the time can be made up in Phase 2.

In discussion with the PMU, we understand that TRL will arrange logistical facilitation for the workshop, and claim back agreed costs as part of the reimbursable workshop expenses budget.

8 Next Steps and Work Schedule

8.1 Suggested output revisions

In order to plan the timing of the Phase 1 workshop and to allow some flexibility with the dates, we propose revisions to the timing of Phase 1 as shown Table 6. The proposed minor modifications of the schedule, should not delay completion of Phases 2 and 3.

Table 6 Current and suggested timing of outputs

Output	Phase *(milestone)*	TOR timing *Months since start of project*	Proposed timing *Months since start of project*	Proposed timing *End of Month Year*
Inception Report	1 (1)	1	1	May 2018
Draft Phase 1 Scoping Report	1 (-)	3	3	July 2018
Inter-Regional Workshop Report	1 (2)	4	6	Oct 2018
Phase 1 Scoping Report	1 (3)	5	7	Nov 2018
Peer-reviewed journal paper	1 (4)	6	7	Nov 2018
Conference paper / presentation	2	9	9	Jan 2019
Interim Progress Statement		12	12	Apr 019
Regional Workshop Reports		15	15	Jul 2019
Phase 2 Report		16	16	Aug 2019
Interim Progress Statement	3	18	18	Oct 2019
Conference paper / presentation		20	20	Dec 2019
Phase 3 Report		21	21	Jan 2020
Guidelines	3	22	22	Feb 2020
Inter-Regional Workshop Report		23	23	Mar 2020
Final Report		24	24	Apr 2020
Peer-reviewed journal paper		24	24	Apr 2020

8.2 Work schedule and resources required

At this stage, the proposed resources appear adequate and no additional resources are currently envisaged. The work schedule for all phases is illustrated in Figure 3. The date of the workshop is yet to be finalised, so a broad potential time range has been shown. While there may have to be minor time-shifts in milestones related to the workshop and reporting, it is not envisaged that the overall timing of the project will be adversely affected.

ACTIVITY, MILESTONE AND PERSONNEL SCHEDULE

GEN2136A: The interaction between improved rural infrastructure access and rural transport service provision.

Activities	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
PHASE 1							BREAK	(Break may be one month later, depending on workshop date)																
Inception activities (consultations and search)																								
Acquisition of research papers+reports																								
Comprehensive review of literature																								
Consultation with key stakeholders/Draft Report																								
Inter-Regional Workshop + Report								(date to be negotiated)																
Revision of Draft Scoping Report																								
Detailed framework for Phase 2 and 3																								
Preparation of Journal Paper																								
Inception Report																								
Draft Phase 1 Scoping Report																								
Inter-Regional Workshop Report								(depends on workshop date)																
Phase 1 Scoping Report								(depends on workshop date)																
Peer-reviewed Journal Paper								(depends on workshop date)																
PHASE 2																								
Final selection of study countries/roads																								
Conference paper/presentation																								
Preparation of data collection methods																								
Data collection and analysis																								
Regional Workshops + Report																								
Preparation of Phase 2 Rpeort																								
Capacity Building Initiatives																								
Conference paper/presentation																								
Interim Progress Report																								
Regional Workshops Reports																								
Phase 2 Report																								
Activities	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
PHASE 3																								
Drafting of Guidelines																								
Conference paper/presentation																								
Preparation of Phase 3 Report																								
Revision of Draft Guidelines																								
Inter-Regional Workshop + Report																								
Preparation of Final Report																								
Preparation of Journal Paper																								
Interim Progress Report																								
Conference paper/presentation																								
Phase 3 Report																								
Guidelines																								
Inter-Regional Workshop Report																								
Phase 2 Report																								
Peer-reviewed Journal Paper																								

Experts	**Total Days**	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
Team Leader/ Transport Expert	115	5	5	5	5	5	5		5	10	5	5	5	5	5	10		5	5	5	5	5		5	5
Senior Researcher - Sociologist/Economist	115	5		5	5		5		5	10	10	5	5	10	10	10			5		5	5	5	5	5
Senior Research Engineers (2No.)	100	5		5	5		5			5	5	5		5	5	5					5			5	
										5	5	5		5	5	5					5			5	
Local Researchers (2No.)	70										5	10	10		5	5									
											5	10	10		5	5									
Total	400																								

KEY

abcd Milestones

Activity length

Invoice Milestone due

Intermittent input

Figure 3 Work schedule for all phases

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Annex 1 Overview of relevant LVRR information in AfCAP and AsCAP countries

1. Democratic Republic of Congo (DRC)

The Democratic Republic of the Congo has fewer all-weather paved highways than any country of its population size in Africa—a total of 2,250 km, of which only 1,226 km are in good condition. According to the United Nations Joint Logistics Centre (UNJLC), total road network was estimated at around 170,000 km (UNJLC, 2006). This consisted of:

- paved: 2,250 km
- unpaved: 15,000 km
- tracks 43,000 km
- country roads 21,000 km
- local roads or footpaths 90,000 km
- total: 171,250 km

To put this in perspective, the road distance across the country in any direction is more than 2,500 km (e.g. Matadi to Lubumbushi, 2,700 km by road). The figure of 2,250 km converts to 35 km of paved road per 1,000,000 of population. Comparative figures for Zambia and Botswana are 721 km and 3,427 km respectively.

2. Ethiopia

In the 1990s, Ethiopia had one of the lowest road densities in the world, but heavy investment in road infrastructure has seen this improve over the last 20 years. In 2009, the road network was almost 50,000 km, with an annual average growth rate of almost 10%. From 1991 to 2009, 28,000 km of new roads were constructed (Worku, 2011). Approximately 14,000 km of the network was of gravel construction. However, in 2008, only 33% of the rural population had access to an all-weather road within 5 km, which with a rural population of about 80 million, translates into a limitation on mobility. Community roads are also important in Ethiopia, with a stock of 57,000 km in 2007.

Ethiopia now has one of the highest economic growth rates in the world. The paper by Endale and Otto (2017) provides a good before and after study of the interaction between infrastructure and transport services for one road. Other sources of information are the recent impact studies carried out on the Universal Rural Road Access Programme (URRAP) for the Ethiopian Roads Authority where substantial amounts of traffic data have been collected (Ethiopian Roads Authority, 2017).

3. Ghana

Road transport is by far the dominant carrier of freight and passengers within Ghana and carries over 95% of all passenger and freight traffic. Roads are classified under three categories of trunk roads, urban roads, and feeder roads. The Ghana Highway Authority, established in 1974, is tasked with developing and maintaining the country's trunk road network totalling 13,367 km, which makes up 33% of Ghana's total road network of 40,186 km.

The AfCAP project ‘Alternative Surfacing for Steep Hill Sections in Ghana’ (GHA2065A), being undertaken with the assistance of CSIR, will be a useful source of information. The project involves the evaluation of suitable surfacings for use on steep sections. Steep sections affect what type of transport services may use a road. Thus the project will provide a source of information as to how transport services were considered in the selection of the surfacings. The CSIR project team and the DFR will be a useful source of contacts for specifics of the project.

Another project that will provide similar information is the AfCAP project ‘Investigation into the suitability of roller compacted concrete as pavement material in Ghana’ (GHA2081A) being undertaken with the assistance of Aurecon. The effect on transport services of roller-compacted-concrete used on steep slopes could be investigated through this project. Both AfCAP studies should provide useful before and after

classified traffic count data. Some documents regarding these projects exist on the ReCAP website. Contacts will be DFR, CSIR and Aurecon.

On national roads there are inter-city bus and minibus services (known as tro-tros). On rural roads, the transport services include tro-tros and taxis (notably on market days) and motorcycles and three-wheelers (although it is currently illegal to operate passenger transport services using motorcycles and three-wheelers). A recent AfCAP project (GHA2050A) has investigated transport services in Ghana, with studies on three rural roads undertaken in 2017. This study identified two issues relating to interactions between transport services and road infrastructure. The Hatorgodo—Abor LVRR road in the southeast has been upgraded with an asphalt surface, but still motorcycle taxis are the main transport services as the road lacks conventional transport services on non-market days (Afukaar, Peters and Damsere-Derry, 2017a). On the Wechiau—Wa LVRR route in the west, conventional transport services opt for a medium-quality road with good transport demand rather than a better road with few villages to serve (Afukaar, Peters and Damsere-Derry, 2017b). These have been discussed here in the literature review.

4. Kenya

According to the Kenya National Highways Authority (KeNHA) website there are 63,574 km of classified roads in Kenya, out of a total of 177,800 km. Of those, approximately 40,000 km are secondary and minor roads, which could be classed as rural roads.

The work done in the context of the Roads 2000 project will be a useful source of information for before and after studies on rural roads. The 'Ex-Post Evaluation of the AFD/GoK Roads 2000 project' provides a substantial amount of 'before and after' traffic and engineering information on eight project and two control roads that would be suitable for including in the analysis (Hine and Bradbury, 2016).

Kenya has a dedicated rural roads authority (Kenya Rural Roads Authority or KeRRA) that could provide important information for this project. There has been traffic count data collected on AfCAP-supported trial sections after the ex-post evaluation study. Another key stakeholder involved in rural transport studies in Kenya is IFRTD. Our key contacts in Kenya will therefore include KeRRA, AFD and IFRTD.

5. Liberia

Liberia has 11,500 km of roads, of which 622 km are paved (5%) and 6200 km are feeder roads (Liberia, 2018). Responsibility for the roads lies with the Ministry of Public Works (MPW), which has a Feeder Road Department. On-going reforms (supported by the World Bank) include the establishment of a Road Fund and a Road Agency, with devolution of responsibilities for feeder roads to local government envisaged. There are two major feeder-road projects supported by USAID (FRAMP Project) and the Swedish Embassy (LSFRP3). AfDB supports some feeder-road rehabilitation through the Smallholder Agricultural Productivity Enhancement and Commercialization (SAPEC) Project of the Ministry of Agriculture. Following successful pilot initiatives on the labour-based construction of motorcycle trails (Jenkins and Peters, 2016), the National Multimodal Transport Masterplan envisages connecting all off-road villages in Liberia to the road network with motorcycle trails (Cardno IT Transport, 2018). This reflects the huge importance of motorcycle taxis for rural transport in Liberia. A recent AfCAP project (RAF2044K) has investigated gender-mainstreaming implications of the motorcycle trails in Liberia.

Transport services are regulated by the Ministry of Transport. This Ministry concentrates its limited human and financial resources on transport regulation in the capital, Monrovia, with some presence in county capitals and at 'regulatory' barriers. The Ministry does not have reliable data on transport services, apart from the operations of the parastatal NTA bus company that runs buses in Monrovia and on a few national routes (Starkey et al, 2017).

GIZ is supporting a project to improve capacity in the transport sector, and has technical assistance staff assisting both MPW and the Ministry of Transport.

An on-going AfCAP project (LIB2135A), implemented by the University of Birmingham, is assisting the MPW and LSFRP3 to establish a monitoring system for feeder-roads. This will include several indicators relating to

transport services, to allow an understanding of the mobility-related outcomes of feeder road rehabilitation and maintenance. The pilot baseline survey was scheduled for June 2018.

6. Malawi

The road network is composed of 15,451 km of which about 26% are paved. In addition, there are 9,478 km of community roads, which serve rural areas. More than 70% of internal freight and 99% of passenger traffic are on roads, with road transport handling more than 90% of international freight and passenger traffic. It is estimated that 55% of the costs of production are taken up by transportation costs in Malawi, compared to 17% in other developing countries (Malawi Roads Authority, 2018). In recent years, the Malawi Road Authority has undertaken a large backlog maintenance programme which has improved the overall condition of the network.

In Malawi international and national transport markets are segmented; the cost of the latter rises significantly as empty backhauls and journeys covering small distances are being overcharged by the few transport companies operating in rural areas. A potential policy for lower transport costs in that market would be to encourage a 'domestic and small vehicle transport sector', hence promoting intermediate means of transport (IMTs) would be a possible solution (Lall, Wang and Munthali, 2009).

7. Mozambique

Mozambique has approximately 30,000 km of road, with almost 20% of that total being paved. The shape, geology and geography of the country (that borders three land-locked countries and has 3,000 km of coastline) make it challenging to establish an effective road network due to the large distances, the high cost of constructing roads and the scarcity of good materials. In addition, Mozambique endured a long civil war during which infrastructure development was put on hold and the road network suffered as a result.

The national roads authority is the Administração Nacional de Estradas (ANE). The road network consists of Primary, Secondary, Tertiary and Local roads, but there is also a large quantity of unclassified district roads. The ANE website shows the paved status of roads and gives information on current and proposed road upgrades. There are reasonable maps available. Approximately 6.5 million rural people do not have access to a road in good or fair condition in Mozambique, with climate events and natural disasters hampering agricultural productivity.

8. Sierra Leone

There are 11,700 km of highway in Sierra Leone, of which 936 km are paved (Ministry of Works, Housing and Infrastructure, 2011). Road transport is the dominant mode of transport in Sierra Leone and represents about 85% of the entire transport system. 95% of the inland transport of passengers and goods is carried out on roads. Of the 11,700 km of the public road network, 8,700 km are functionally classified in the National Road System. The other 3,000 km consist of local roads and unclassified roads and tracks (Ministry of Works, Housing and Infrastructure, 2011). The Sierra Leone Roads Authority (SLRA) manages the national roads. The Ministry of Transport and Aviation (MoTA) provides the policy and regulatory framework for transport management in Sierra Leone. It is the overall body responsible for policy formulation in the area of road safety in the country. The Ministry of Works, Housing and Infrastructure oversees the policy guidance and execution of the road, housing and infrastructure sectors in the country. It is in charge of the construction, reconstruction, rehabilitation and overall maintenance of road sector infrastructure. It assumed management of feeder roads a few years ago.

Current transport demand is modest. It is estimated that in 2012 there were fewer than 700 freight trips per day (255 million tonne-km per year) on the national (long-distance) road network, and about 7,000 passenger trips daily (1,083 million passenger-km per year). The projected growth in the economy and people's well-being is high and – given the relationship between economy and transport demand – will translate into increased trips and also changes in trip nature. Total road trips are projected to grow at nearly 11% per year, reflecting improved incomes and associated increased trade. The transport system is configured to provide basic access to, and within, the country. Except for the mining sector, in most cases the capacity of the existing components will be adequate for some time.

A recent AfCAP project (SLE2108A) has investigated transport services in Sierra Leone, with studies on three LVRR undertaken in 2017. On two of these roads (in the north and the central part of the country), about ninety percent of passenger and freight movements were on motorcycle taxis. However, on the road studied in the south, there were minibus services and light trucks on market days that complemented the motorcycle taxis, and these larger forms of transport services accounted for about 40% of the annual passenger and freight transport (Mustapha and Peters, 2017).

9. South Sudan

South Sudan is a largely rural country with 83% of households residing in rural areas and 78% of households dependent on farming or livestock as their primary livelihood. Despite this, much of the food is imported from the neighbouring countries of Uganda and Kenya. When the country became independent in 2011, its road network was 12,642 km. Of these, 4,000 km were all-weather gravel roads, and the rest were tracks and trails. Most roads were not receiving proper maintenance, and were in poor to very poor condition, especially in rural areas that were largely inaccessible during the six-month rainy season (April to October). These conditions made transportation in South Sudan slower and more expensive than anywhere else in Africa, which hindered farmers sourcing and transporting of key inputs (such as seeds or fertilizers) to their farms and moving their products to the local and regional markets. Poor rural transport has limited the potential for agriculture to contribute to overall economic growth (AfDB, 2012).

With proper maintenance, low-volume roads will serve to keep communities connected. These rural roads connect into trunk roads, which, in South Sudan, are also mostly gravel and are in very bad shape, especially during the rainy season. South Sudan has not yet moved toward a road investment strategy that results in a strong network of trunk, secondary and local access roads. This is mostly because of the magnitude of the challenge—South Sudan did not have a single paved road until shortly after its independence in 2011. Now, South Sudan has a road network of over 14,000 km of primary and secondary roads, but only 300 km of paved road (World Bank, 2017).

10. Tanzania

Tanzania has several trial LVRR sections that were built under AFCAP1 in association with Roughton. These roads used various surfacing options with varying effects on rural transport services. Design and monitoring reports exist on the ReCAP website. The sections are currently being monitored by Tanzania Rural and Urban Roads Agency (TARURA) with the assistance of CSIR.

Tanzania has a rural road network, managed by TARURA, of approximately 109,000 km, although recent estimates put this figure at closer to 120,000 km. Of this total, only about half are classified, which means that the remaining half receive no maintenance. The government is undertaking a process to review and update the network accurately.

The DFID-funded programme ‘Improving Rural Access in Tanzania’ (IRAT) could also provide a valuable source of information. Its Cardno-managed component ran from December 2013 to January 2018, and consisted of road engineering interventions at key ‘bottleneck’ locations to improve the accessibility of existing roads through the construction of bridges, drifts and culverts, raising embankments and improving running surfaces on steep slopes. Traffic survey data, together with transport charges and market prices were collected over five rounds of counts in three years (2015, 2016 and 2017) on up to 28 roads, including wet and dry season counts on project and control roads. In total it was possible to make before and after comparisons (with control observations) on ten roads that had major “bottleneck” interventions including new bridges, culverts and embankments (Cardno, 2017).

Our key contacts in Tanzania are TARURA, CSIR, Roughton and Mott McDonald. Another key stakeholder involved in rural transport studies in Tanzania is IFRTD.

11. Uganda

The Uganda road network comprises approximately 21,000 km of national roads; 17,000 km of district roads; 2,800 km of urban roads and about 30,000 km of community roads, connecting communities and districts. Road transport is by far the most dominant mode of transport in Uganda, carrying over 95% of

passenger and freight traffic. National roads currently make up 25% of the road network but carry over 80% of the total road traffic.

Paved roads are generally in good condition, but unpaved roads are susceptible during the wet season. Traffic volumes are high, with light vehicles and motorcycles (commonly referred to as boda-bodas), common, particularly in, and around, urban areas.

In 2010, a number of rural access roads were constructed through the assistance of DANIDA and the DFID-funded programme CrossRoads. The project was under the oversight of the Mount Elgon Labour-based Training Centre (MELTC). The key contact in Uganda would be MELTC to gain access to the transport considerations before construction and the impact observed to date.

12. Zambia

Zambia has a road network of 67,671 km; rural roads are in poor condition, making it difficult for small-scale farmers to access markets for their produce. The road network is the backbone of the Zambian transport system reaching remoter areas where other modes cannot. Zambia has a gazetted road network of approximately 37,000 km of which 6,476 km are bituminous. The gravel and earth roads account for 8,478 km and 21,967 km respectively. In addition, there are about 30,000 km of ungazetted community road network comprising tracks, trails and footpaths. A large part of the main road network was constructed between 1965 and 1975, and over the years the country's road infrastructure has been eroded through lack of sufficient maintenance. Key funding agencies include the World Bank and the AfDB.

13. Afghanistan

The road network in Afghanistan consists of 8,200 km of national and regional highways, 9,700 km of provincial roads, about 23,000 km of rural roads and 3,000 km of urban roads. Following several years of conflict, much of the rural road network is in poor repair. Only 7% of roads are paved. Afghanistan is heavily reliant on international aid to support the development of its road network.

The vehicle population is increasing rapidly, with the recent average annual growth at 23% for cars, 15% for trucks, and 48% for motorcycles.

Since 2002, Afghanistan has launched major programmes for improving its road network with the help of various international partners. The main agencies are the Ministry of Public Works, the Ministry of Rural Rehabilitation and Development and the Ministry of Transport and Civil Aviation. The main development organisations active in the road sector in Afghanistan are the World Bank, USAID, EU, ADB and DFID. The Government is implementing the National Emergency Rural Access Project (NERAP) and National Rural Access Programme (NRAP), which provide for the construction and rehabilitation of rural roads.

In general, transportation in Northern provinces is mostly hindered by difficult winter weather, especially in those places where the snowfall and rain start early. In areas prone to landslides and flooding, transport may be delayed due to temporary road blocks. There are some remote areas where there is no means of access once the snow starts to fall.

14. Bangladesh

Bangladesh has a large rural road network with 342,764 km of roads in different categories (LGED Database, 2016). The Local Government Engineering Department (LGED) manages all rural roads (Upazila, Union and Village roads) which form more than 93% of total roads, or about 321,462 km. In 2017, 97,000 km of rural roads were paved.

Much of the country is low-lying and is vulnerable to flooding. Rural roads are responsible for connecting some 87,000 villages, but many still remain unconnected. ReCAP funded a project to develop a methodology for the planning and prioritisation of rural roads, following a combination of a network approach to rural road planning and prioritisation based on cost-benefit analysis and multi-criteria analysis, with stakeholder participation.

The main agencies for rural road transport are LGED and Local Government Institutions. The main development organisations active in the road transport sector are the World Bank, ADB, JICA and SDC.

15. Myanmar

It has been estimated that more than half of Myanmar's population live in villages without access to an all-season road. An ADB study in 2016 estimated that Myanmar has about 75,000 km of all-season roads. It was suggested that it would need a 250,000 km network to connect all villages, as about 9 million people are living in about 25,000 villages that are not connected by any road (Starkey and Cartier van Dissel, 2016). The main modes of transport to these villages are by walking or bicycle, with most goods being carried by people or on the backs of animals. Another 20,000 villages are connected by a road that is not all-season. Vehicles are used in the dry season, but the roads are likely to become impassable during the rainy season.

The Rural Access Index (RAI) shows the portion of the rural population that live less than 2 km away from an all-season road. Myanmar's RAI is estimated at 36%, which is possibly the lowest in Asia. The planning goal is to connect all villages by 2030. Resources put into road infrastructure are inadequate, especially for maintenance.

The main agencies for rural road transport are the Department of Rural Road Development, the Department of Progress of Border Areas and National Races Development, the Town Development Committees and Public Works. The main development organisations active in the road transport sector in Myanmar are ADB, World Bank, EU, JICA, KfW and DFID.

At present the demand for rural transport services is low, with infrequent services and high costs. Faced with no other alternative, people expend a large effort in carrying goods or procuring transport, with women often bearing the burden of this. Most rural transport services involve intermediate means of transport (including motorcycles, three-wheelers and power tillers) that are operated by local small-scale entrepreneurs (Starkey and Cartier van Dissel, 2016).

16. Nepal

Nepal has a rural road network of approximately 60,000 km of road, with about 5% of this paved (World Bank, 2013). The majority of this network has evolved without formal planning. In 1999, the Department for Local Infrastructure Development and Agricultural Roads (DoLIDAR) introduced the concept of District Transport Master Plans, which is a tool for the districts to plan their rural road network in an inclusive and participatory manner. It took some time for all districts to fully embrace the concept, plus the predominant mode of rural road construction relies on staged construction over several years, so the number of roads that have been properly planned is relatively low.

There is anecdotal evidence that the development of transport services on the rural road network is very slow. This was noted in a review of the District Roads Support Programme (DRSP) that supported the building of labour-based roads. The review concluded that roads are an enabler of accessibility, but do not directly lead to increased activity alone, as there are many other factors that come into play (Stickland, 2009). Operators of transport services, whether buses, trucks, jeeps or three-wheelers tend to form powerful cartels. Another review of DRSP roads found that bus cartels appeared to inhibit the development of smaller forms of public transport on rural roads (Starkey, Tumbahangfe and Sharma, 2013)

The main agencies for rural road transport are: DoLIDAR and the District administrations (recently under transformation). The main development organisations active in the road transport sector in Nepal are the World Bank, ADB, SDC, DFID and GIZ.

17. Pakistan

Pakistan has a road network of approximately 260,000 km. The main road network is 9,200 km, with Provincial, District and Municipal, Government and Army roads comprising the remainder (Abedin and Batool, 2017).

Since 1991, road transport in Pakistan has grown annually by 10.6% for freight and 4.4% for passengers. Road transport is the dominant transport mode, moving about 95% of inland freight and 90% of passengers

(Neumann and Buhat-Ramos, 2006). The main modes of rural transport are bicycle, auto-rickshaw, motorcycle and tractor/trailer for freight (Abedin and Batool, 2017).

The main agencies for rural road transport are under the Provincial Governments, and include the Community and Works Department, the Planning and Development Department and the Transport Department. There is also a National Transport Research Centre, which was established in 1974.

The main development organisations active in the road transport sector in Pakistan are ADB, JICA, World Bank, DFID, USAID and GIZ.