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Guidelines on the Planning, Design and Implementation of Rural Transport

Integrating Access Infrastructure and Transport Services Provision

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Cover photos. Paul Starkey: Motorcycles on the Chekimaji-Kawaya road, Hai District, Tanzania and a 35-seat bus rounding hairpin bend with stone soling on the Kavre road studied in Nepal.

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Abstract

These guidelines are provided to assist rural road authorities and the agencies with responsibility for rural roads to collaborate with the departments charged with regulating transport services and local authorities in order to provide and maintain roads fit-for-purpose for the prevailing transport services. The guidelines derive from the 'Interactions: Maintenance-Provision of Access for Rural Transport Services (IMPARTS)' project funded by UK Aid, which examined how investments in low-volume rural road (LVRR) construction (provision) and maintenance (preservation) affect rural transport services (RTS). Improved RTS are vital for enabling access to facilities including markets, health centres, education and socio-economic opportunities. A summary is provided of the main RTS types and their operational characteristics. While road investments are often justified by envisaged RTS improvements, few road authorities have collected RTS information. An integrated and devolved institutional approach is recommended with the authorities responsible for roads provision and transport services working with district authority staff of several disciplines and consulting with transport services operators and a diverse range of rural people.

In the guidelines, participatory processes are advocated to develop district transport master plans, highlighting priority roads and off-road villages requiring motorcycle trails to reach the road network. Various maps are suggested to facilitate understanding and planning. Some relevant indicators are the Rural Transport Premium (RTP) and the Rural Access Index (RAI). Options relating to road design are proposed noting their implications for costs and transport services. The importance of maintenance is stressed. Options for improving rural transport services are suggested, including ways of increasing predictability and consolidating demand when few people travel. Various available resources are highlighted to assist planning and prioritisation processes, determining appropriate infrastructure design choices and understanding rural transport services options and safety issues.

Key words

Road planning; Transport services; Rural mobility; Motorcycle trails; Rural road outcomes; Rural road impacts; Rural road preservation; Rural road provision

Research for Community Access Partnership (ReCAP)

Safe and sustainable transport for rural communities

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

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Acronyms and Units

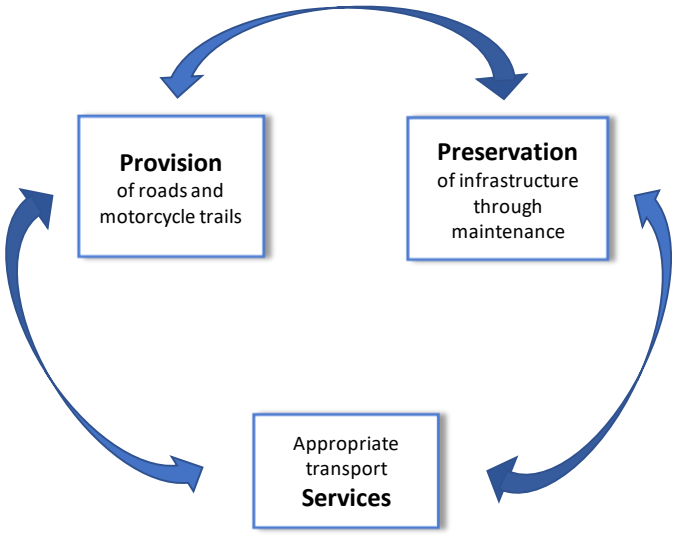
4x4	Four Wheel Drive
AfCAP	Africa Community Access Partnership
ADB	Asian Development Bank
CBO	Community Based Organisation
DDC	District Development Committee
DFID	Department for International Development, UK
DoLI	Department of Local Infrastructure
DoLIDAR	Department of Local Infrastructure Development and Agricultural Roads
DRCC	District Roads Coordination Committee
DROMAS2	Road database in Tanzania
DTMP	District Transport Master Plan
e.g.	For example
GIS	Geographic Information System
GPRTU	Ghana Private Road Transport Union
GPS	Global Positioning System
h	Hour
HDM-4	Highway Development and Management Model version 4
ILO	International Labour Office/Organisation
IMPARTS	Interactions: Maintenance-Provision of Access for Rural Transport Services
IMT	Intermediate Means of Transport
IRMH	International Road Maintenance Handbook
IRAP	Integrated Rural Accessibility Planning
IRI	International Roughness Index
IRR	Internal Rate of return
k	thousand
kg	Kilogram
km	Kilometre
Ksh	Kenya Shilling
LVRR	Low-Volume Rural Road
LVS	Low Volume Seal
m	Metre
MCA	Multi-Criteria Analysis
NGO	Non-Governmental Organisation
NPV	Net Present Value
ORN	Overseas Road Note
Pax	Passengers
PIARC	World Road Association
PMU	Project Management Unit
RAI	Rural Access Index
RAMS	Road Asset Management Systems
ReCAP	Research for Community Access Partnership
RED	Roads Economic Decision model
RTP	Rural Transport Premium
RTS	Rural Transport Services
SDG	Sustainable Development Goal
SEACAP	South East Asia Community Access Programme
SSA	Sub-Saharan Africa
SSATP	Sub-Saharan Africa Transport Policy Program
SuM4All	Sustainable Mobility for All (World Bank, Washington DC)
TP	Technical Panel
TRL	Transport Research Laboratory
UK	United Kingdom
UKAid	United Kingdom Aid (Department for International Development, UK)
USD	United States Dollar
USDc	United States Dollar cents
VAT	Value Added Tax
VDC	Village Development Committee
VOC	Vehicle Operating Costs
WIDP	Woreda Integrated Development Plan

1 Introduction to these Guidelines

1.1 Research project context

The Research for Community Access Partnership (ReCAP), funded by UKAid, commissioned TRL to undertake a research study to gain, and to disseminate, a greater understanding of how investments in low-volume rural roads (LVRRs) impact rural transport services and the mobility of people and their goods. This project was known as IMPARTS (Interactions: Maintenance-Provision of Access for Rural Transport Services). It explored the interaction between the effective use of rural access and its dependency on the appropriate provision and preservation of LVRRs, and the resultant changes in rural transport service provision that are brought about through improved sustainable road performance. A diagram illustrating the continuum of infrastructure provision, its preservation (maintenance) and transport services is shown in Figure 1. These guidelines derive from the IMPARTS research project and are based on literature reviews relating to rural infrastructure and transport services, surveys undertaken in Nepal and Tanzania and stakeholder consultations. Full details of the research activities and findings are provided in a series of reports that form the basis of these guidelines (Starkey and Hine, 2020; Starkey et al., 2019a, 2019b, 2019c, 2020b, 2020c and 2020d).

Figure 1 Diagrammatic illustration of the provision-preservations-services continuum



1.2 Target audience

The guidelines are intended to assist professionals in rural roads agencies and in the authorities responsible for rural transport as well as officials within devolved administrations concerned with improving rural transport. The guidelines should also be useful for policy makers in the ministries, departments and authorities responsible for planning, rural roads, transport regulation and road safety. They are primarily intended for use in low- and middle-income countries in Africa, Asia, Latin America, the Caribbean and the Pacific although some of the issues raised will be relevant elsewhere.

1.3 Guideline structure

Section **Error! Reference source not found.** introduces these guidelines and how they have been developed.

Section 2 provides guidelines for achieving informed decision making on the local priorities for rural roads and trails and their anticipated transport services. This section is at the heart of these guidelines.

Section 3 discusses the design options for different categories of rural transport infrastructure that may be appropriate to different types and volumes of transport services.

Section 4 discusses related maintenance issues and options to ensure investments in road infrastructure are preserved at affordable costs.

Section 5 presents some options for improving the transport services and their regulation, including road safety issues.

The concluding Section 6 points to further information sources and possible ways forward.

Annex 1 provides additional background about the need for, and the benefits of, rural transport services with examples of the types of rural transport services and ways in which they are organised and regulated.

Annex 2 provides additional examples relating to planning road investments and examples of how data collection can illustrate changes to transport services resulting from such investments.

1.4 Context and understanding

Through the IMPARTS research project, other professional assignments and published literature, the authors are familiar with rural road and transport services issues in numerous countries worldwide. They are convinced that the approach to planning rural roads and transport services presented in these guidelines will prove beneficial. Their gradual implementation should help eliminate some costly misjudgements concerning road investments and, over time, improve rural transport services.

While there are examples of elements of these guidelines that have been successfully adopted by projects and institutions around the world, there are no clear examples where organisations have incorporated all the recommended practices presented here, as part of a replicable strategy. These guidelines are derived from the experiences of many different countries, but there is no perfect solution. All decisions will have to be based on some forms of compromise, to ensure transport infrastructure provision and transport services can be affordable and readily available to rural women, men and children.

One key issue to stress from the outset, is that while there are many similarities in the ways rural transport services operate around the world, each country is unique. There can be important differences between regions within the same country. The best way forward in each country will depend on numerous interacting local factors, including geographical characteristics, socio-economic conditions and governance structures. The intention of these guidelines is not to be prescriptive, but to offer potential options and ways forward.

All options, whether related to transport services types or infrastructure specifications, are compromises between affordability and quality. Rural people and government decision makers aspire to high quality options. The financial reality often means that limited budgets can go further, benefitting more people, if implemented standards are below the best quality option. Such compromises are inevitable but are sensitive and depend on local circumstances. These guidelines are not intended to be prescriptive as to the standards to employ but are meant to assist decision-makers in keeping transport provision affordable.

Discussions on transport services options, and photographic illustrations of these, include issues that appear to be sub-optimum and possibly dangerous. For example, it is universally illegal to overload transport services vehicles, including motorcycles. These guidelines are not in any way condoning poor practices or dangerous transport services. The examples given are all based on current practices in some countries, and there is discussion on ways of improving local enforcement, mindful that the highest standards may limit people's access to transport, possibly leading to worse outcomes for rural people.

1.5 Options for interventions, a piloting approach and the sharing of experiences

These guidelines provide options that, if implemented within the context of existing planning and data collection frameworks, should lead to rural infrastructure and rural transport services that are appropriate to the needs of rural communities. Not all options will be appropriate in all circumstances: the guidelines offer a menu of options, allowing people and organisations to select those considered most suitable for their local circumstances.

The emphasis of these guidelines is on actions at a devolved level. It is suggested that implementing organisations should trial data collection, local transport planning and initiatives for improving transport

services in particular districts and build upon the positive experiences gained (and address any problems encountered). The lessons can be shared with other districts through workshops and exchange visits, to initiate a snowballing effect of increasing adoption based on local experiences and best practices.

Implementing organisations are also strongly encouraged to share their experiences with other countries. The authors would be grateful to receive feedback on the experiences of pilot implementations as would the commissioning organisation, ReCAP.

2 Planning Rural Access Suitable For Rural Transport Services

2.1 Overall goal of rural access and mobility at affordable community costs

2.1.1 Overall goal and key guidelines

The goal of universal rural access and mobility is embedded in the Sustainable Development Goal (SDG) target 9.1:

> *"Develop quality, reliable, sustainable, and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all." (UN, 2015)*

The Sustainable Mobility for All (SuM4All) initiative provided the following four guidelines to help to achieve rural access under the SDG target 9.1 (SuM4All, 2019).

- Access should be provided for all people.
- Access should be affordable and equitable.
- Infrastructure should support economic development and human well-being.
- Infrastructure should be quality, reliable, sustainable, and resilient.

A more comprehensive list of guidelines was identified in the United Nations 10th Environmentally Sustainable Transport Forum in Asia in 2017, held in Vientiane, Lao. It is referred to as the Vientiane Declaration on Sustainable Rural Transport (UNCRD, 2017).

- Promote inclusive, affordable, accessible and sustainable rural transport infrastructure and services.
- Improve access to basic utilities and services including health and education by the rural poor, farmers, agricultural workers, girls and women, youth, and physically disabled and vulnerable groups.
- Improve investments in new rural roads and ensure adequate maintenance of rural roads.
- Explore climate adaptive road and infrastructure investments in rural areas to enhance resilience of local communities.
- Promote environmentally sustainable transport in rural areas by introducing low-carbon transport system and avoiding road development without environmental consideration.
- Improve rural transport connectivity to wider local, national and regional transport networks.
- Improve transport safety, sustainability and efficiency in rural areas.
- Explore innovative solutions to improve rural-urban connectivity; to improve and green supply chain logistics (from producers to consumers); to achieve safe and sustainable rural access; to achieve resource and energy efficiency in rural transport services; and to reduce local air and water pollution as well as mitigate, and adapt to climate change.

A diversity of possible actions has been identified. There is clear emphasis on inclusivity and leaving no one behind. There is need to consider all rural people, whatever their ethnicity, status, gender, wealth, age or ability. Services need to be affordable (i.e. provided at minimum cost to the users) and general welfare and safety need to be considered. This provides an overall context for rural transport policy and planning.

2.1.2 Key outcome objective: minimisation of community transport costs within a district

In order to meet the goal of rural access and mobility and provide guidance relating to both infrastructure and transport service interventions, a useful outcome objective is the ***'minimisation of community transport costs'*** for any proposed level of intervention. Funds are limited for the support of both infrastructure and services, so, in order to get the best outcome for the funds spent, the objective may also be expressed in terms of ranking interventions in terms of the following ratio:

Reduction in community transport costs / Associated intervention costs

To achieve the lowest level of community transport costs for a given budget, the interventions with the highest ratios should be the selected in turn, until the total intervention budget is exhausted.

Community transport costs can be defined as the total combination of passenger fares, freight tariffs, running costs of not-for hire vehicles and unpaid personal travel time. If an intervention is planned then transport costs, fares and tariffs, may be expected to change both because operating costs (and fares and tariffs) of particular modes may change, because the road surface is in a better condition, or the journey distance is shorter, or there is a switch in modal composition. This is a local approach (e.g. district based) to ensure the travel needs of rural people are met at minimum cost to household resources. With this approach, data would be required on passenger and freight tariffs and travel times. It would be necessary to include value of personal travel time, personal freight transport (such as headloading), and the direct running costs of vehicles used for personal and household use (such as bicycles, motorcycles and cars).

Examples of transport costs, fares and tariffs, together with key road engineering characteristics that affect modal composition are included in Annex 2. The use of the Road Economic Decision Model (RED) to help predict vehicle operating costs, based on road condition is also discussed in Annex 2.

While the guidance of the SDG processes, SuM4All and the Vientiane Declaration point towards the outcome objective of minimising community transport costs within districts, no formalised process has yet been devised to assess and model these costs in a consistent way. Further research is required to develop and test modelling procedures. If there is available data on fares and tariffs it may be possible to develop spreadsheet models to compare different scenarios. There are also some simple indicators that can be readily obtained, such as the Rural Transport Premium, defined as the ratio of rural transport fares compared with long distance transport fares expressed on a per passenger-km basis (see Section 4.7.3), that can assist as partial proxies for community transport costs. In the short-to-medium term, it is envisaged that roads authorities will continue using conventional tools for comparing investment options.

2.2 Existing planning procedures and economic models

Within a District there are likely to be a range of rural transport infrastructure options that may be considered for investment. For rural road planning a range of tools are used, and many countries already have clear guidance on the use of these. Tools include Ranking (often referred to as Cost-Effectiveness Criteria) and Cost Benefit Analysis using models such as the Road Economic Decision Model (RED) and the Highway Development and Management Model (HDM-4). Multi-Criteria Analyses (MCA) are also used that combine and rank a range of different criteria. RED and HDM-4 may be used to help predict the change in ***'community transport costs'*** for different road investment interventions. The procedures vary in terms of their data requirements and relative complexity. RED and HDM-4 estimate underlying vehicle operating costs according to road condition. They also adopt economic discounting over the lifetime of the road investment and hence can help analyse the effect of different maintenance alternatives and budget scenarios, while ranking procedures adopt more simple comparisons of road investments at the same time.

Where traffic volumes are low and vehicle access is prevented during the wet season, or being introduced for the first time, Ranking or simple Cost-Effectiveness Criteria can be particularly useful tools. RED and HDM-4 may be used when a formal economic analysis is required, particularly to meet donor requirements. RED is a relatively easy-to-use spreadsheet-based model that is mainly used when traffic volumes range between 50 and 300 conventional vehicles per day. HDM-4 is a more complex model that requires specialist training and is mostly used for roads with higher traffic volumes. It can also be used to test and refine a wide range different road engineering designs. Further information on the different approaches is included in Annex 2, and a more detailed discussion of different planning criteria is available in a World Bank document on 'Planning infrastructure and services' (Hine, 2014).

The guidelines presented in this document provide a framework for district-level planning that allows information to be gathered from many different sources, participatory discussions of the issues and joint analyses of the likely effects of road investments on rural transport services and people's mobility. Economic analyses, using any of the tools mentioned according to local requirements, can be performed as part of the planning processes. However, it is strongly recommended that the final results are discussed with the stakeholders to allow the 'common-sense' of transport operators and users to challenge dubious modelling results. None of the modelling systems is perfect, with various assumptions and biases being introduced as the data is manipulated.

2.3 Institutional Arrangements

2.3.1 The current situation

Planning and regulating transport services is generally the responsibility of a separate ministry or department. These ministries or departments tend to be small, and concentrate on administrative matters (licensing, testing, taxing) and regulating urban and inter-urban transport. This is discussed further in Annex **Error! Reference source not found.**. Due to the small size of their administrations, they are seldom represented by many senior personnel at district level. If they are, the main tasks of the devolved staff generally relate to administrative compliance and not to planning transport services. Partly for this reason, very little proactive planning of transport services takes place at district level. District councils may be delegated the responsibility of issuing route licences for certain types of conventional transport services. The initiative to request such licenses generally comes from the operators themselves. Currently, it is most unusual for transport authorities to develop master plans of how they would like to see the different types of transport services improve their coverage of possible routes. Most of the transport services operating on LVRRs are informal sector operators, frequently operating beyond regulatory scrutiny and often being non-compliant with national regulations. Few, if any, transport services regulating authorities have data on the numbers of vehicles operating on LVRRs and the tariffs they actually charge. While districts often have a planning officer whose work spans many disciplines, it is most unusual that such planners regularly collect data on transport services, tariffs or even traffic flows. These guidelines intend to assist the transport services authorities, the roads agencies and the district authorities to work with local transport operators and proactively develop local transport plans, covering roads, trails and transport services.

Currently, the staff of roads authorities have little or no training relating to transport services and may feel uncomfortable talking to transport services operators and/or collecting data on transport services as this is not perceived as their responsibility. Transport services regulatory staff are not generally available at a district level to provide the data on rural transport services required for road planning. Given there is a recognised need to have an integrated approach to providing rural roads and transport services, some forms of modified institutional arrangements are required, so that acting together, integrated plans can be developed.

2.3.2 Suggested new approaches

As each country will have different institutional systems and priorities, the following suggested approaches are offered as possible ways of improving the integration of road infrastructure planning and transport services planning and/or increasing collaboration in the processes.

- Combine or integrate the ministries/departments responsible for roads and transport services at a national level.
- Delegate administrative processes relating to licensing, testing and taxation to a specialised agency to free the transport services regulatory staff to concentrate on planning and improving transport services.
- Allow and encourage district-level staff of rural roads authorities to engage with, and obtain data from, transport services on the LVRRs for which they have responsibility.
- Provide training relating to understanding rural transport services, their operational systems and key data to collect for district level planning officers and to district staff responsible for planning rural roads and transport services.
- Consider establishing a specialised unit, or delegating existing staff, to facilitate district level integrated approaches to planning rural roads and transport services and to provide training in the processes and the data collection methods.
- Establish a specialised unit in the ‘roads and transport’ authority (or the roads authority) to tackle the specific issues relating to increased motorcycle use (and other IMTs), including the design and construction of low-cost infrastructure such as motorcycle trails and trail bridges.
- Provide training to district-level staff about the specific issues relating to increased motorcycle use (and other IMTs) on LVRRs and the benefits and practicalities of constructing motorcycle trails and trail bridges.

2.4 District level planning

2.4.1 An overview of the proposed approach

These guidelines are advocating a devolved approach to planning rural roads and transport services. This document refers to 'district-level planning' but this can be interpreted according to the specific hierarchies of devolved government in the implementing countries. Reference to planning at 'county-level', 'municipality-level' or 'commune-level' (francophone countries) may be more appropriate in some countries. Working at the devolved level provides opportunities to directly involve rural communities and rural transport operators in the planning and development of rural transport. Multi-disciplinary district-level planning is not new and has long been used by district-level development projects and initiatives. It has already been systematically established in many countries, with varying degrees of consistency and continuity. Examples are given in Section 0.

The approach involves the relevant road authorities/agencies, the transport services authorities and the district councils cooperating at district level. They will develop processes to consult with key stakeholders including rural communities and transport services operators. Specific mention is not made here of the special interest of schools, health facilities, agricultural enterprises and other key services as the institutional interests are assumed to be represented through the district authorities and the various user interests should be voiced by the rural communities. Similarly, it is assumed that the district councils and communities will use the processes to help address the special needs of women, young people, people with disabilities and disadvantaged groups.

In the following sections, some steps involved in the consultation and planning processes are recommended. These include understanding local transport hub-and-spoke patterns, preparing various maps in collaboration with the transport operators and the rural communities and collecting the required data. There should be discussion on people's priorities for roads and motorcycle trails and suitable options for improving existing transport services. Some of the various district-level activities are summarised in a simplified flow chart in Figure 2. How these activities could fit into the development of a national strategy are summarised in Figure 12 at the end of this document.

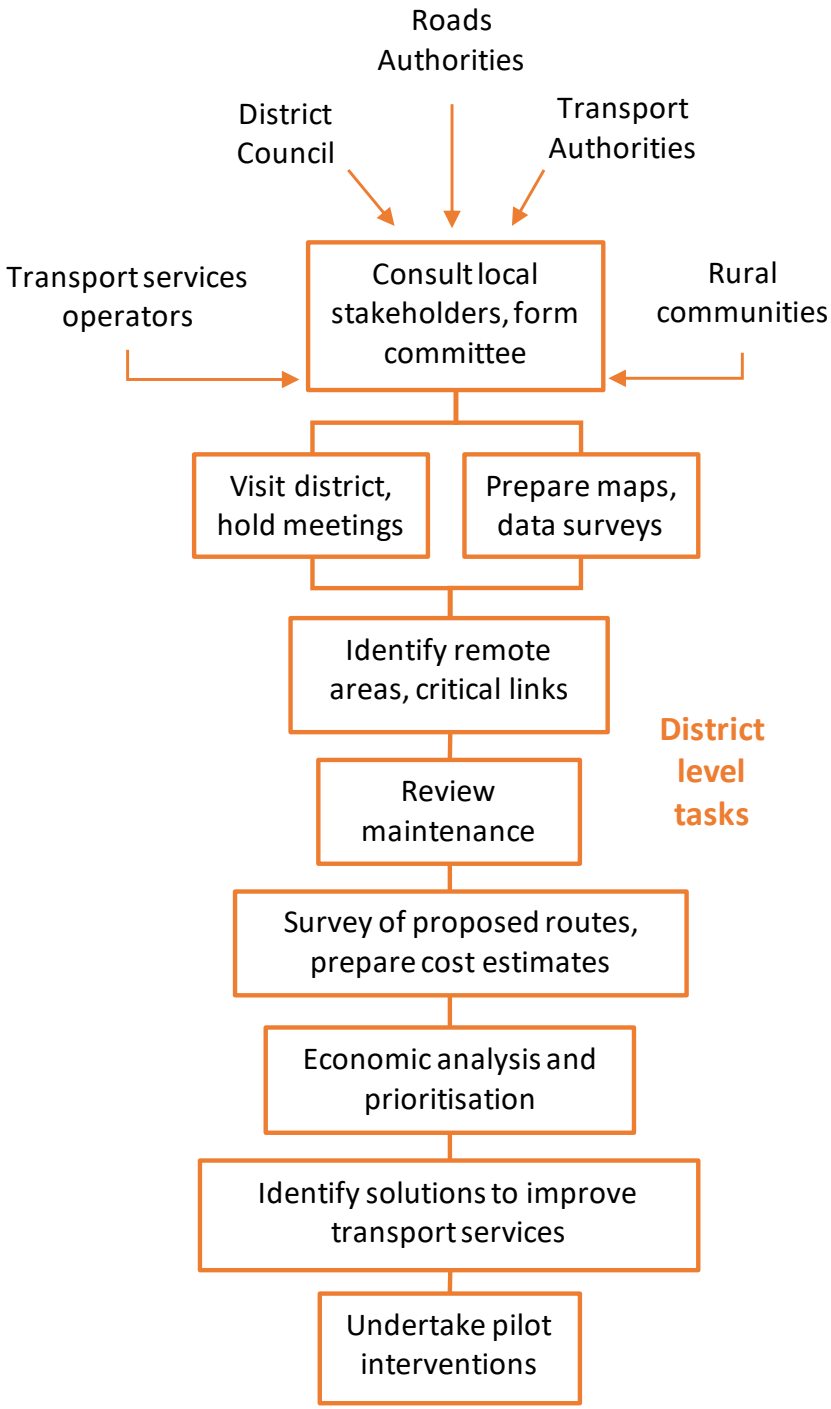
2.4.2 A first step: form a District Transport Master Plan Coordinating Committee

The DTMP planning process will involve several institutions and many stakeholders. One of the first steps will be to form a committee (or other coordination system) that will oversee the processes, delegate specific tasks and ensure the quality and timeliness of the various tasks and outputs. The composition of the DTPM committee will depend on local circumstances and organisational structures. It is likely to be chaired by a senior representative of the district authority although someone from the roads' authority/agency might assist with this. It is likely to include representatives of district level specialised departments (planning, transport, health, education, agriculture, environment, women's concerns, etc.). The road's authority/agency may be represented at district level and possibly at national/provincial level as well. The transport services authority would also be represented at district level and/or at national/provincial level. Depending on local circumstances, transport operators could be represented, as could influential development NGOs/CBOs.

At an early stage, one of the main tasks would be to prepare a list of the key activities required and to delegate responsibilities for implementing and for monitoring these. Many of the infrastructure-related surveys and data collection might be delegated to staff from the roads' authority/agency. It may be appropriate to engage consultants or interested NGOs to undertake some tasks. Local NGOs may be valuable for assisting with the stakeholder discussions with local communities, however the road engineers and those responsible for transport services should also engage with some of these consultations to learn more about local problems and priorities.

In the following sections, various recommended activities will be described. It will be assumed that the DTMP Coordinating Committee will assign the related implementation responsibilities to appropriate individuals or organisations.

Figure 2 Simplied flow-chart illustrating some of the district-level activies proposed



2.4.3 Examples of district level planning of roads and transport services

In Ethiopia, the local districts are known as Woredas, and under the Ethiopian Rural Travel and Transport Programme a multi-disciplinary, district-based planning process was widely implemented, generating many Woreda Integrated Development Plans. These included important non-transport infrastructure (relating to health, education and agriculture) and schemes to promote the use of intermediate means of transport (including bicycles, animal-drawn carts and three-wheelers). A summary of some of the processes and issues is provided in Box 1.

Box 1 The Woreda Integrated Development Plans undertaken in Ethiopia

Under the Ethiopian Rural Travel and Transport Programme a series of district (Woreda) development plans were developed using accessibility as a key tool to integrate the various components. The programme was administered by the Ethiopian Roads Authority but with representation of other ministries. Initially a series of manuals were produced covering planning, rural transport infrastructure, transport services, non-transport interventions and income generation and resource mobilisation and management. In 2001, eight pilot Woreda Integrated Development Plans (WIDPs) were produced.

It was recognised that, in view of the diversity of Woreda characteristics a 'one-size-fits-all' approach would not be appropriate. By 2008, 130 WIDPs had been prepared or were under preparation. The plans produced were comprehensive, covering significant investments in agriculture, health, education, as well as transport infrastructure and Intermediate Means of Transport (IMT). Implementation of each plan was the responsibility of the Woreda officials, with the roads desk responsible for overall coordination. A wide range of planning procedures were adopted, including IRAP, transport cost-benefit analysis and conventional financial accounting approaches.

An assessment of the implementation of the eight pilot WIDPs, in relation to the transport related components, was carried out in 2008. The assessment found significant improvements in both accessibility and socio-economic conditions resulting from road investments (of varying standards), provision of IMTs, and increased provision of facilities such as health posts and schools.

Source: IT Transport, 2008.

Since the 1990s, a district level planning approach has been developed and used by the rural roads authority in Nepal. This approach led to the systematic preparation of District Transport Master Plans (DTMPs). The processes are summarised in Box 2.

Box 2 District Transport Master Plan process in Nepal

The District Transport Master Plan (DTMP) process in Nepal provides a good example of a widely-implemented, inclusive, bottom-up approach to planning road network development. The objective of a DTMP is to facilitate and prioritise district roads over a five-year period, to support the development of a sustainable road network that reduces aggregate transportation cost and minimises environmental impacts. The DTMP process was introduced to minimise ad-hoc practices of investing in roads based on short-term considerations and political contingency. The DTMP provides a fundamental base for planning and implementing new construction and upgrading existing district roads, with the aim of providing the basis for a process of sustained growth.

A key tenet of the DTMP process is the participatory approach of public consultation with local authorities, involving all important stakeholders at crucial stages of the planning process. A crucial process is the formation of a District Roads Coordination Committee (DRCC), initiated by the Chairperson of the District Development Council (DDC). This ensures participation of the district in the entire planning, decision-making, programming and implementation process. The DRCC coordinates the local planning and construction of roads, trails and trail bridges.

Following the formation of a DRCC, general field surveys are carried out to develop a better understanding of the socio-economic conditions and priorities, related to access to services, trading routes, agricultural production, development potential and an inventory of existing roads and trails. When this is complete, the information is plotted on available maps to create a thematic map of transport infrastructure and district location at the national level, and the district road inventory. The data collected from field surveys is used to identify potential areas for investments in roads. This provides the basis for further discussions with the DRCC to identify roads for detailed study in the district. At this stage regional synchronisation is considered by identifying roads that could benefit more than one district. An indicative development potential map of the district is then prepared.

Local workshops are held to record the requirements of local people for transport connectivity. This is carried out in the presence of Village Development Committee (VDC) secretaries, local key informants, social workers, representatives of local political parties, women and disadvantaged groups, and representatives of NGOs and CBOs. The preliminary demand for transportation is collected from meetings of the VDC, where the basic transport requirements for that village are discussed.

After a good understanding of the district situation has been established, the DRCC discusses the investment in roads and identifies the priority roads to be proposed to the DDC for new construction and rehabilitation. Once the roads have been identified the environmental impacts and mitigation strategy is considered. The local engineer carries out a detailed socio-economic survey and engineering feasibility study of the proposed corridors. An estimate is prepared to identify the rehabilitation or construction costs for each road.

The next step is to analyse all the factors used to prioritise roads, such as demography, agricultural potential, market/service centres, traffic flows, social and engineering aspects and special considerations such as religious and tourist sites. A weighted scoring system is developed. Each road is assessed, and the results are discussed with the district officials. The prioritisation is decided transparently in the context of available resources for each district.

A draft DTMP is produced and distributed to all VDCs for their information and consideration. When VDC feedback is complete and any adjustments have been made, the draft DTMP is presented to the DDC for approval. This part of the process should involve as many stakeholders as possible, including local politicians, line agencies and members of parliament. When final approval is received from the DDC, the DTMP is presented to the Department for Local Infrastructure and the National Planning Commission. Many examples of District Transport Master Plans can be seen on the website of the rural roads' authority in Nepal (DoLI, 2020).

In addition to the DTMPs, districts in Nepal also worked with their neighbouring clusters of districts to produce District Transport Perspective Plans. These considered travel between districts and to reach national destinations to ensure there were synergies of provision and no unnecessary duplication of key routes.

Note: the DTMP process did not explicitly refer to including rural transport services operators in discussions. By involving village-level stakeholders, issues relating to rural transport services constraints could be raised. The authors of these IMPARTS guidelines recommend that specific mention is made of involving transport services operators.

Source: DoLIDAR, 2012.

An entire methodology for participatory planning of access and mobility at a devolved level was developed by the International Labour Office (ILO) and other organisations. The ILO process was known as Integrated Rural Accessibility Planning (IRAP) and large numbers of documents and resources are available to assist with this process. The development of these and other ideas is summarised in Box 3.

Box 1 Integrated Rural Accessibility Planning (IRAP) and other integrated approaches

In the 1980s and 1990s, the International Labour Office (ILO), with the support of Swiss Development Cooperation and other agencies, was working on labour-based approaches to road construction. *ILO* was concerned that conventional rural road planning was not sufficiently integrated with the wider issues of poverty reduction and rural development. An important early output was the ILO publication 'Rural transport in developing countries', stressing the importance not only of roads but also IMTs and technologies to reduce headloading (Barwell et al., 1985). Other collaborating organisations, including the Intermediate Technology Development Group, agreed with this approach. Through various collaborative initiatives, this led to the creation of the International Forum for Rural Transport and Development (IFRTD) and the formation of the IT Transport consultancy, both of which were strong advocates of multidisciplinary integrated approaches.

The Makete Integrated Rural Transport Programme in Tanzania (1985-1996) proved particularly important in recording and publicising links between rural poverty and transport, and influencing national and international policies (Lema, 2007). This project was before the days of widespread motorcycle use*, so there was no emphasis on these*, but in addition to road construction, work was carried out on village trails and the use of donkeys. A second influential publication was 'Roads are not enough: new perspectives on rural transport planning in developing countries' (Dawson and Barwell, 1993).

The integrated approach was taken up and further developed by the Sub-Saharan Africa Transport Policy Program (SSATP) hosted by the World Bank (Malmberg Calvo, 1994 and 1998; Ellis and Hine, 1998; Lebo and Schelling, 2001; Starkey, 2001; Starkey et al, 2002; Starkey, 2007a and 2007b; Banjo et al., 2012; Hine, 2014).

The pioneering accessibility planning work of ILO was developed into a clear methodology know as Integrated Rural Accessibility Planning (IRAP). This was trialled in the Philippines, Malawi, Cambodia and other countries, and numerous valuable reports and training resources were produced that are still extremely valid and helpful today (Dingen, 2000; Donnges, 2003; van Dissel, 2003; ASIST AP, 2004).

Multidisciplinary teams would work with villagers and discuss and map possible transport investments such as roads, footpaths and trail bridges as well as non-transport investments such agricultural stores, schools, clinics, wells, woodlots, electricity supplies. The various options and priorities are discussed with stakeholders and with personal travel time a key criterion. A similar approach was applied to district level access and facilities, and this was used in Cambodia, in association with labour-based construction methodologies (Rozemuller et al., 2002a and 2002b).

While there is much information available on participatory and inter-disciplinary planning methodologies available, these methods have not yet been fully 'mainstreamed' into roads agencies. There has been a tendency within national roads authorities, and in donor agencies, for engineers to work in professional 'silos', concentrating only on engineering issues. Work for roads authorities (and supporting donor agencies) on evaluating road impacts, transport services and rural mobility has often been delegated to social scientists, universities and consultancies. The institutional environments did not favour multi-disciplinary approaches. Even during the initial years of the first phase of AFCAP, there was no work relating to transport services and there was serious opposition to AFCAP adopting an integrated approach. However, from the outset, ReCAP adopted a more integrated approach, and has highlighted the importance of the provision-preservation-services continuum that was illustrated in Figure 1. These guidelines are designed to promote that integrated approach.

Four aspects of the work of the IMPARTS project further highlighted the existing problems that need to be resolved through the more integrated approach being advocated here.

- From the literature review, it was found that there has been little research on rural transport services. Road impact studies have seldom collected data on transport services (Starkey et al., 2019a).
- From discussions with road authorities in all ReCAP countries, it was clear that there is no systematic collection of transport services information by roads agencies (Starkey et al., 2019a).
- From the IMPARTS stakeholder workshop, it was found that participants wanted a more integrated approach and would welcome advice on how to achieve this (Starkey et al., 2019b).

- From the IMPARTS field research, examples were shown of road investments that were made without sufficiently consulting local residents and transport services operators, leading to some inappropriate investments (Starkey et al., 2020c and 2020d).

Another reason for the lack of uptake of district-level planning includes its time-consuming nature, and the high degree of devolved responsibility required. Much district level planning of rural transport interventions has been carried out with ear-marked funding provided by donor-assisted projects. In the cases of Ethiopia mentioned in Box 1 and Malawi and Cambodia mentioned in Box 3, extra personnel were available to assist with the processes. In normal, non-project settings, the national authorities do not have sufficient funding or personnel resources to provide comprehensive additional resources to assist the detailed planning of all districts. For this reason, district-level training will be required, and pilot planning initiatives are recommended in these guidelines.

2.4.4 Understand transport hubs, transport watersheds and national connectivity

While the DTMP is prepared at district level, with district stakeholders, it must consider wider transport issues and existing transport hub and spoke systems. Hub and spoke systems are described in Annex 1 and illustrated in Figure 17. **The DTMP should not be a 'district-centric' plan, concentrating only on internal connectivity**. In Nepal, districts have prepared District Transport Perspectives Plans covering several districts to ensure there are synergies and lack of duplication. The district town will probably be the centre of operations for the district council, but many people living in the district may wish to travel to markets and towns outside the district. District boundaries seldom conform to existing transport watersheds: people in various parts of the district, may want improved access to different transport hubs in neighbouring districts. Travel to cities outside the district may be more important to them than travel within the district. Box 4 shows examples from Ethiopia and Tanzania where districts provided high specification roads to improve within-district travel, only to find very little traffic (and no transport services) used the roads. This was because district residents wanted to travel to the nearby city that was outside the district. Within district connectivity could have been assured through roads of a much cheaper standard.

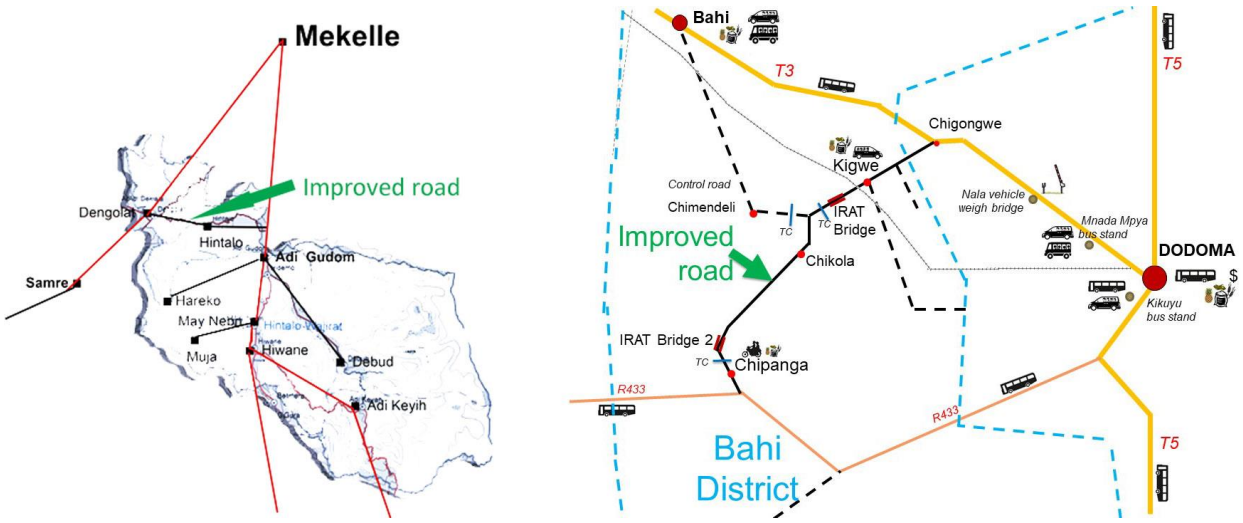
- Understand and map the hub and spoke patterns within the district and those linking to transport hubs and markets outside the district.
- Identify key destinations for people within and outside the district and ensure these are served by appropriate rural infrastructure and transport services.
- Do not over-estimate within district travel requirements and ensure that infrastructure specifications are appropriate to realistic transport demand.

2.4.5 Use participatory methods to work with stakeholders and understand their different priorities

In order to develop appropriate DTMPs, it will be necessary to have inter-disciplinary discussions within district administrations and undertake participatory consultations with key stakeholders.

- Involve all relevant departments in consultations and planning, including planning, roads, transport services, health, education, agriculture, environment, gender, business development.
- Initiate participatory consultations at grass roots level, including representatives of all relevant stakeholders.
- Ensure representation of different types of transport users, including women, men, older persons, students, people with disability and all minority groups.
- Consider the benefits of some within-village meetings.
- Consider the advantages and disadvantages of holding joint or separate discussions with the various types of transport services providers, and whether discussions will be most open and informative if meetings are held with many operators at or near one of their transport terminals.
  Be aware that the various types of transport service may have different and competing interests. Their leaders may have vested interests and may not represent all operators.

Box 4 Two schematic maps of improved roads that did not stimulate transport services



The picture shows two schematic maps. The left one is Hintalo Wajirat District (woreda) close to the city of Mekelle in Ethiopia. The right one is Bahi District close to the city of Dodoma in Tanzania. In both these examples, an across-district road was improved significantly, but transport services did not respond to the expensive improvements. This was because in both cases, the roads linked two major spokes serving nearby cities. The transport services were responding to the transport demand to reach the city along the different transport corridors (the main road spokes). Most people travelling on transport services wanted to go the city. Only the small number of villagers living along the road and a few district officials wanted to travel on a road across the district. Had the district planners talked with the transport services operators, they would have explained the minimal transport demand between the different transport corridors. This would have allowed the planners to opt for cheaper road design standards, which would have given better value for money.

Sources: Starkey, 2007a and Starkey et al., 2020c

- Consider, with stakeholders, the existing provision of roads, trails, and transport services, their condition and relative importance and a range of local development factors that could influence the use of roads and the development of transport services, including market access, agricultural potential and access to healthcare, education, employment and business development.
- Consider, with health officials and village representatives, the infrastructure and transport services provision to allow for daily access to health facilities and arrangements for emergency transport to health care. Identify gaps and prioritise needs.
- Consider, with education officials, school and college representatives and village representatives, the infrastructure and transport services provision to allow access to primary, secondary and tertiary education. Identify gaps and prioritise needs.
- Consider, with agricultural officials, and representatives of large and small farmers, the infrastructure and transport services provision to allow access to markets and the provision of inputs. Identify gaps and prioritise needs.
- Consider, with officials responsible for gender, inclusion and minorities and with appropriate representatives of women, older persons, people with disabilities, minority groups the special needs of these (and other groups) for infrastructure and transport services provision. Identify gaps and prioritise needs.
- Consider with the various stakeholders other factors that can determine the nature of road provision and transport services, such as safety, environmental impact and resettlement provision.

2.4.6 Always keep expectations realistic

- Inform all district colleagues and stakeholders about the estimated costs and range of likely investments over time and avoid over-ambitious plans and expectations.
- Offer choices, suggest compromises and seek consensus in prioritisation.

If money were no object, all stakeholders would advocate for the highest standards in all situations. This would not assist planning, as funds will be limited. Some consensus prioritisation is required and compromises will have to be made. Each expensive initiative proposed is likely to rule out several lower-cost options.

2.4.7 Scale consultations and data collection to realistic levels

- Do not be daunted by the number of relevant stakeholders, the large range of issues to consider and the many options for data collection.
  Adapt these guidelines to the time and resources available for the planning exercise. With so many possibilities to consider and stakeholders to consult, district level planning can appear excessively complicated. Be reassured it has worked in many countries, but that it will be necessary to scale the extent of consultations and data collection to the time and resources available.

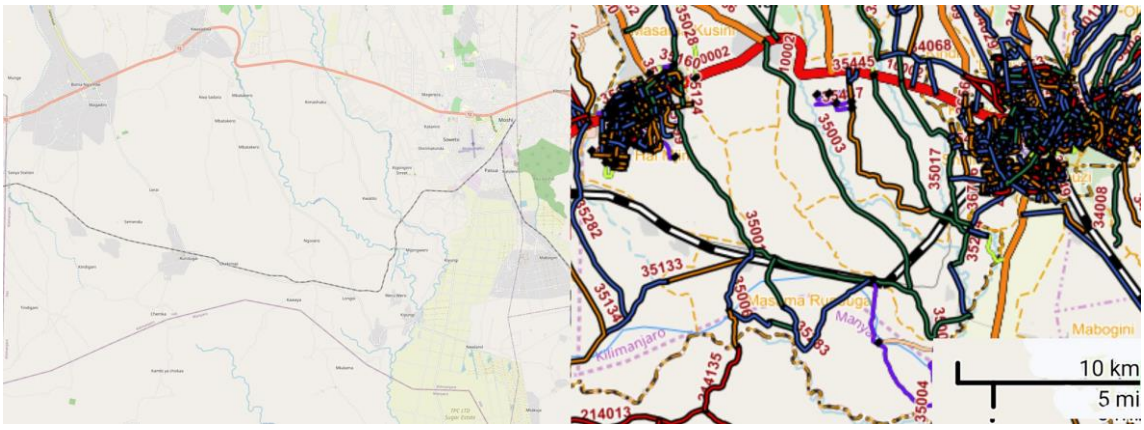
- Delegate effectively to improve consultations and data collection.
  Certain tasks such as focus group discussions and collection of data on traffic flows and transport services tariffs can be delegated to village officials, local schools, NGOs or CBOs. However, be aware that delegation can result in biases due to the vested interests of the implementers.

2.5 Prepare maps showing villages, roads, facilities, destinations and transport routes

Maps are a crucial tool to assist planning. Several types of maps can be developed. These are complementary showing different scales and levels of detail. A single district planning map may be a valuable outcome, but it should derive from several types of map, some of which may only have been sketches or schematic representations of key routes and destinations. With increasing use of GIS in district level planning, the planning map can be made of many layers (although not all the detail will be visible in the overall summary map). Layers should include roads of different categories, motorcycle trails, transport services routes, villages, towns, population, markets, health facilities, educational establishment and other key characteristics of the district and its connectivity to other districts and the national road network.

- Prepare and reproduce a simple map of the district showing the road network (and trails to off-road villages), key towns and villages and facilities such as markets, health centres and schools.
  A simple map with the basic road network, external connections and key destinations for travelling will be invaluable when talking with villagers about their preferred destinations, with operators about their hubs and routes and with specialists in agriculture, health and education about transport needs and priorities.

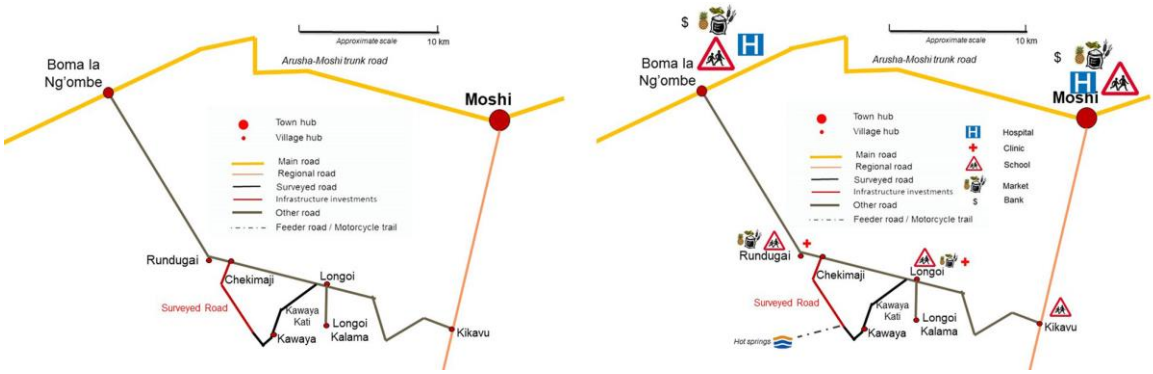
Figure 3 Examples of source maps from Tanzania providing the starting points for local planning maps



Note: The left map is from Open Street Maps; on this the LVRRs do not show up clearly at this scale (hence the value of schematic maps as shown in Figure 4 and Figure 5). The right is from the DROMAS2 national database of urban and rural roads. Most countries have GIS maps of their classified roads, but these may not show important unclassified roads or motorcycle trails.

- Prepare sketch maps of key destinations with village stakeholders.
  The IRAP guidelines show many examples of village-based maps showing local walking routes around specific villages. For district-level planning, the maps need to be of a wider area and developed with representatives of several villages. They should indicate their preferred destinations for shopping, health care etc, bearing in mind these destinations may not be directly connected by roads and may be in other districts.

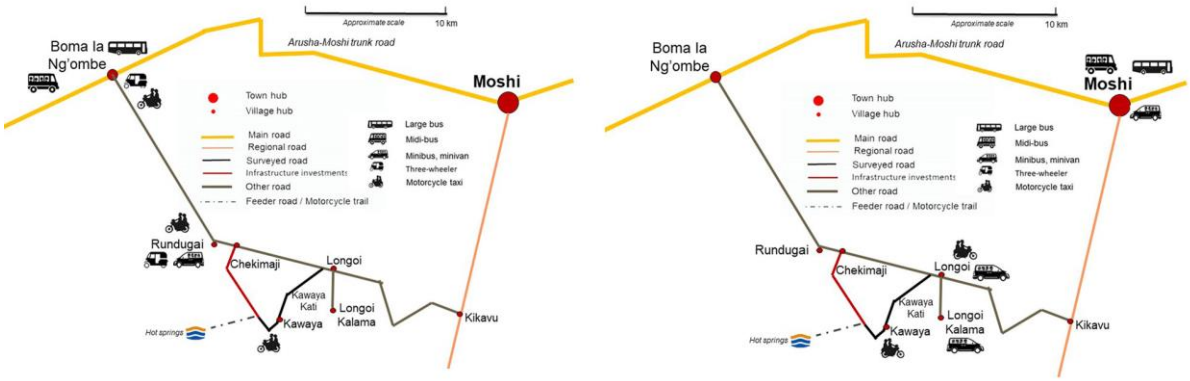
Figure 4 Two schematic planning maps from Tanzania showing key roads, villages and destinations



Note: Both maps are based on the same roads shown in Figure 3. The map on the left shows key LVRRs and villages in the area being studied. The map on the right shows key destinations, including large and small markets, primary and secondary schools, clinics, hospitals and banks.

- Prepare schematic maps of existing transport hubs and routes, with transport operators.
  With transport services map their main routes and alternative route options, noting operational days and frequencies. Identify key hubs outside the district (e.g. cities) and within the district (e.g. district town) and subsidiary hubs (e.g. temporary markets, road junctions).

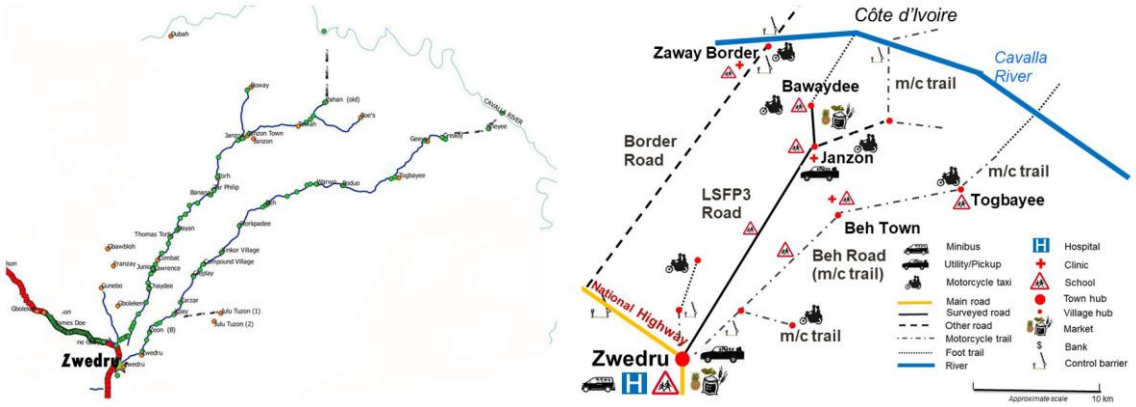
Figure 5 Two maps from Tanzania showing rural transport services operating to/from two different hubs



Note: These maps are of the same roads and villages as Figure 3 and Figure 4, and illustrate two different 'transport catchments' in the same local area. The map on the left shows that from Rundugai people and transport services travel mainly to Boma la Ng'ombe. The map on the right shows that from Longoi people and transport services travel mainly to Moshi. The road investments (in red) were around the boundary of the two transport 'watersheds' and had little influence on the existing transport services, and only motorcycle taxis operated regularly on the improved road.

- Prepare maps showing all off-road villages and their proximity to the road network.
  These maps can identify existing motorcycle trails and potential to construct new trails to provide motorcycle trail access to off-road villages.

Figure 6 Example of map showing on-road and off-road villages in Liberia with motorcycle trail connections

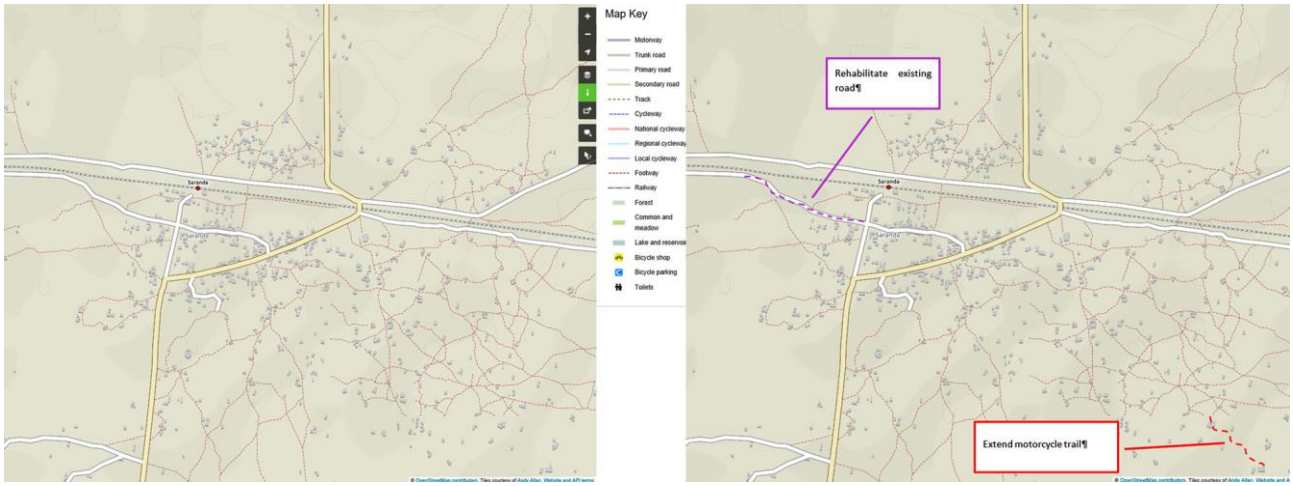


Note: The maps show an area of Liberia close to the large Cavalia river that is the border with Côte d'Ivoire. The left map is based on GIS information of village locations and GPS tracks acquired using pickups and motorcycles; this shows most villages are based on old road alignments, but some are off the road network but connected by simple earth motorcycle trails. The right map is a schematic planning map, based on the GIS/GPS map, plus information supplied about key destinations and transport services. The Beh Town road used to be a road, but it has deteriorated so much it can only be used by motorcycles. Other motorcycle trails to off-road villages have evolved from footpaths and old forestry tracks, and are maintained by villagers. Apart from the omnipresent motorcycle taxis, there are pickup services between Zwedru and Janzon on market days. Minibuses and pickups provide inter-urban services on the national road.

- Prepare road categorisation maps.
  On the basic road map, identify the national/provincial roads. For the district-level roads note their passability and identify which are strategically the most important (typically those essential for connecting large numbers of people/villages) and those of lesser importance (because they serve fewer villages and/or alternative routes are available). Note that the lower importance roads can still be prioritised in the interests of passability, inclusivity and new development options. There is open source mapping that can facilitate this process, such as Open Street Map, as shown in Figure 7. This is essentially a crowdsourced map of every country, freely editable by the community of users. The classes of road are shown on the right and can also be edited. The data for each road can be obtained and will include information such as surface type, condition, passability and classification. It also maps footpaths and trails.

- Prepare local road and route prioritisation maps.
  Following initial consultations, prepare maps with the proposed interventions that have been provisionally prioritised, including road rehabilitation and motorcycle trail construction. Use these to consult again with the transport services operators and other stakeholders to ensure awareness of the advantages and disadvantages of the initial choices made. Be prepared to change these in the light of feedback from stakeholders.

Figure 7 Example of OpenStreetMap map for a small rural area in Tanzania showing infrastructure categories

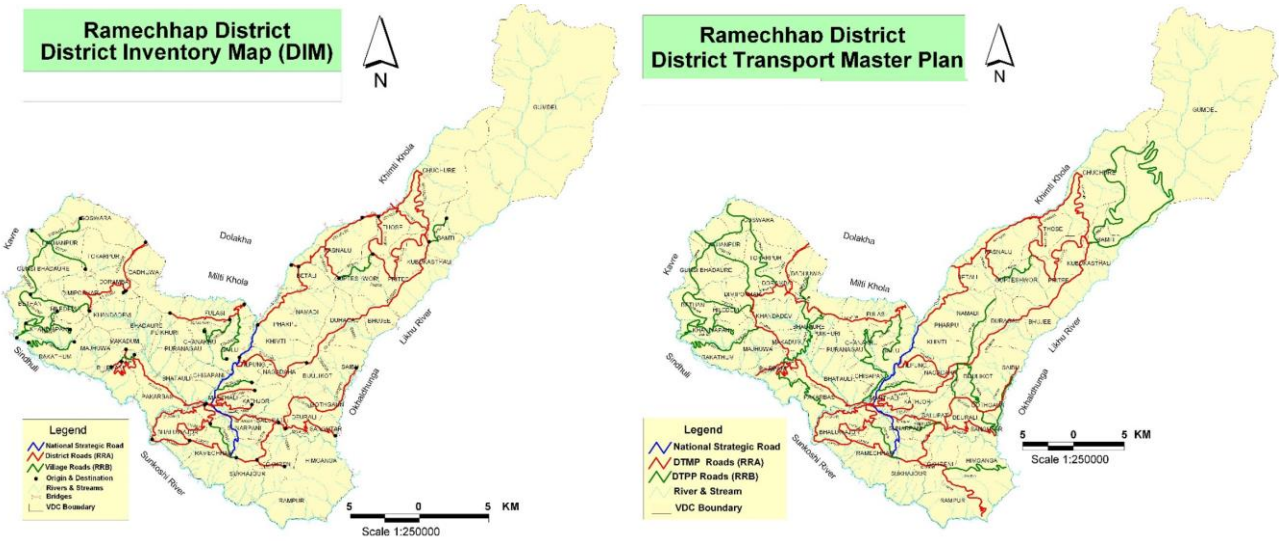


Note: The left map shows the different categories of infrastructure provided by Open Street Map, while the right map is the same, but with the priority investments identified by local residents, including a road rehabilitation and extending a trail to allow motorcycle access to additional villages.

- Prepare District Transport Masterplan maps

  Combine the information from the high-resolution local road, motorcycle trail and transport route prioritisation maps developed with stakeholders to prepare district level investment maps. Ensure sufficient attention has been paid to the importance of travel to destinations in other districts. An example of a DTMP from Nepal is shown in Figure 8.

Figure 8 Example from Nepal of the development of a District Transport Master Plan map



Note: The left map shows the existing situation with national, district and village roads. The right map summarises the DTMP and shows the planned additional infrastructure, noting those roads and trails prioritised by the DTPM work and those identified as important through the District Transport Perspective Plan (which looks at the importance of facilitating travel outside the district).

2.6 Consider needs and prioritisation for infrastructure and transport services

2.6.1 Consider different infrastructure options appropriate to transport demand

The SuM4All in their resource book on providing universal rural access, consider four types of rural infrastructure that are relevant to district-level planning and prioritisation:

- Basic access including paths and footbridges
- Motorcycle trails
- Low volume rural roads
- Higher volume rural roads.

The various characteristics of these in terms of traffic, costs and design issues are summarised in Table 1.

Table 1 Four categories of land access infrastructure

Characteristic	Basic access	Motorcycle trails	Low volume rural roads	Higher volume rural roads
Type of rural access	Existing earth roads and tracks, low-cost trail bridges, causeways	Narrow earth or surfaced tracks, low-cost trail bridges, causeways	Earth roads, gravel roads, low cost surfacing, causeways or engineered bridges	Surfaced roads, paved roads, engineered bridges
Main means of transport served	Pedestrians, bicycles, IMTs, motorcycles, some motor vehicles	Motorcycles, bicycles, pedestrians	Motor vehicles, motorcycles, bicycles, IMTs	Motor vehicles, motorcycles, bicycles
Main transport service providers	Informal services	Motorcycle taxis	Motorcycle taxis, private passenger and freight services	Motorcycle taxis, private passenger and freight services
Typical traffic level (vehicles per day) [a]	< 50 motorcycles and bicycles (for roads and tracks)	50–100 motorcycles	50–200	100–500
Level of maintenance needed	Routine maintenance to clear vegetation, unblock drainage, control erosion	Routine maintenance to clear vegetation, unblock drainage, control erosion	• Routine maintenance to clear vegetation, unblock drainage, control erosion • Grading (earth and gravel) • Regravelling (gravel)	• Routine maintenance to clear vegetation, unblock drainage, control erosion, repair potholes • Periodic overlay or reseal of surfaced roads
Type of improvement	Spot improvements to allow vehicles to pass in all seasons e.g. ford, footbridge, culvert, steep gradients, weak soils	Spot improvements on steep gradients weak soils and water-crossings, engineered tracks	Engineering improvements to sections (spot) or entire roads	Construction of engineered road with drainage
Objective of improvement	Remove blockages to achieve all-season access	Faster, safer and more convenient access using motorcycle taxis	Use by a range of vehicle types, increase safe driving speeds, some roughness reduction	Use by all vehicle types, increase safe driving speeds, roughness reduction
Cost	Low	Low	Medium	High

Source: After SuM4All, 2019; Lebo and Schelling, 2005; Hine, 2014.

Constructing and maintaining roads and motorcycle trails appropriately will help in allowing appropriate transport services to develop. The construction of roads and trails should be tailored to specific local situations, so transport services must be considered at the planning stage of network development.

To effectively plan rural road network development to account for transport services, it is necessary to consider more than just traffic, or predicted generated traffic. Planning has traditionally considered traffic and some economic indicators to identify and prioritise which roads should be constructed, but this is often undertaken with minimal involvement of rural communities. There is evidence that community involvement and transparency in the planning process can enhance the provision and development of transport services (Starkey et al., 2020b). The more participatory the process to identify and prioritise roads is, the more likely it is that appropriate transport services will develop.

It is also essential to involve transport ministries and departments in rural network planning, as well as transport associations and operators. In most countries it is the private sector that decides which transport services are developed and how, depending on factors such as market demand and infrastructure. In the following sections key engineering-related factors are highlighted.

2.6.2 Essential for transport services development

- Prioritise all-season passability.

  All season access is crucial for rural people and to give operators the confidence that they can run transport services year-round as a viable business, including minimising the risk of impassability at key locations such as water crossings and steep areas.

- Consider appropriate horizontal and vertical alignment for the expected vehicle types, especially in hilly or mountainous regions.
- Consider demand for transport services, which can be a stronger determinant of service development than road surface condition.

2.6.3 Influential to transport services development

- Appropriate surface types should be used in accordance with the vehicles expected to use the road, as the passability for different vehicle types will be affected.
- Ensure appropriate road width for the expected vehicle types, as the width will determine the size of vehicle able to use a road.
- Consider the affordability of transport services (passenger and freight fares), if local people cannot afford to use them, they will not be sustainable.

2.6.4 Basic factors to consider that are less important

- Consider the riding quality of the road, although this is not usually the limiting determinant of transport services development.
- Consider road safety for both road users and local communities.
- Consider dust generated from traffic in the dry season, which can be harmful to the health of road users as well as people living alongside the road.
- Consider vehicle operating costs.
- Consider travel times.

2.6.5 Other factors influencing the selection and prioritisation of rural roads

- Cost of construction and maintenance.
  Available budget for construction and maintenance. In general, tolls are not used on rural roads, so funding is most likely to come from central government to a devolved administration at district level, who then carry out the planning process. A whole-life costing approach is recommended, especially when considering surfacing options. The funding approach will vary from country to country, but this is the most likely scenario for rural road funding.

- Information necessary for planning.
  The information available for planning will vary. Some countries have rural Road Asset Management Systems (RAMS). Some may also use 'HDM-4' or 'RED' for planning.

- Political influence in road network planning.
  In any planning process there will be political considerations. These should be identified during the planning process and accounted for.

- Consider infrastructure suitable for IMTs including motorcycles.
  Motorcycles and other IMTs have seldom been considered in the rural road network planning process. However, they are an increasingly important aspect of access provision for rural communities. There are also potential savings to be made by designing IMT access to be complementary to four-wheeled vehicle access.

2.7 Data requirements, indicators and data collection

2.7.1 Overview of types of data required

To undertake a district planning approach a wide range of planning data needs to be collected. Some will already be available, and some will require additional surveys. The envisaged multi-disciplinary implementing committee will oversee the whole process but the responsibility for collection and guardianship will depend on the data sets and the various participating organisations. In some cases consultants may be hired to undertake the data collection. In the medium term, it would be appropriate if most of this information could be retained within road management databases, accessible within the districts.

- A map of the district that shows major features such as towns, villages, major rural markets, facilities such as schools and hospitals, communication links and features such as water bodies, rivers and mountains.
- A list of all population centres with their population.
- Estimates of the Rural Access Index (RAI), discussed in Section 2.8.
- A list of all roads, by category and standard, giving their road length, and condition. If possible, the condition should give an indication of road roughness and seasonal impassability. This may well be available in the Road Asset Management System.
- A list of important tracks and trails that may be considered for upgrading.
- Daily traffic volumes disaggregated by vehicle type and should include pedestrians and cyclists, particularly for the lower standard rural roads.
- A database of fares, freight tariffs, trip distance and main destinations for a selection of roads
- Data on vehicle input prices, fuel and tyre prices and estimates of overall vehicle operating costs
- Data on travel frequency and journey purpose.
- A database of the costs of road maintenance interventions. Previous cost information should be dated so that it can be adjusted for inflation to current prices.

2.7.2 Data for engineering inputs

Information required for planning engineering inputs to effectively develop transport services includes:

- Potential cost of construction
  The potential cost of construction is an important factor in planning rural roads. At the initial planning stage this could be an average cost per kilometre for each type of construction, but for prioritisation a more detailed engineer's estimate will be required which should reflect more closely the cost for a particular alignment. Up to date local costs should be used.

- Whole life costs
  The whole life costs for a road should ideally be taken into account, which would include the maintenance costs as well as the construction costs. This could mean that a more expensive and/or robust surface construction could save money over the lifetime of the road if the maintenance costs are reduced.

- Resettlement
  Land availability and resettlement needs to be considered when planning new roads. Where donor funds are used there is a requirement that land is equitably identified for the road and that everyone who provides land is adequately compensated. The country regulations for locally funded roads are often less strict, but land is almost always compensated for, which can be a significant cost to a road construction project. The data for land availability and cost is an important input into the planning process and should be considered within the context of local regulations.

- Environmental Impact
  Environmental Impact of road network expansion is an important consideration. Donor funded projects require an assessment of the environmental impact of road construction and

rehabilitation. Many country regulations also require similar assessments. The data regarding environmental impact can have a significant bearing on the feasibility and cost of road development and should be considered in line with local guidelines.

- Material sources
  The location and availability of material sources. Road building materials that meet the specifications of rural roads, such as gravel, are becoming scarce. Haulage of road building materials can be up to 50% of the cost of constructing a road if there are no locally available quarries. Therefore, it is essential that the location of appropriate materials is known before planning can take place.

- Road Condition
  When considering maintenance, road condition data is an essential factor used to prioritise roads. Condition data is typically sparse for rural roads, especially unpaved roads, and can be difficult to collect accurately with minimal resources. If maintenance budgets are very low there is little justification for spending on condition data collection. However, this data can often be collected informally by consulting with local engineers and technicians who know the roads well, and this input is better than no information at all. It may also be useful to consider RAI data, if available, to identify which roads are considered to be all-season or not. It is recommended that the most reliable and cost effective measure of road condition is used, given the prevailing circumstances.

2.7.3 Rural Transport Premium

While a wide range of data can be collected on passenger tariffs and freight costs, a useful indicator to collect and use in road planning (and inclusion in road databases) is the Rural Transport Premium (RTP). This is an indicator of the transport benefits provided by rural roads. The RTP is the ratio between the fare per passenger-km of the available public transport services on low-volume rural roads and the fare per passenger-km of standard-class, long-distance bus services.

$$Rural\ Transport\ Premium = \frac{Fares\ per\ passenger\ kilometre\ on\ LVRR(USDc)}{Fares\ per\ passenger\ Kilometre\ on\ long\ distance\ buses\ on\ national\ roads\ (USDc)}$$

It was designed as an indicator that could allow comparisons within and between countries. Being a ratio, there are no units or exchange rate issues, and many potential difficult issues, such as changes in fuel prices over time, the cost of living or idiosyncratic local pricing systems should be cancelled out. There will always be a premium on rural transport prices as long-distance buses are likely to be cheaper, per passenger-km, as they invariably run on better infrastructure (national trunk roads) and benefit from two economies of scale (larger loads and longer distances). Rural transport services typically use smaller vehicles for shorter distances on poorer roads. As roads improve, vehicle operating costs and fares tend to decrease in real terms, particularly if there is competition. If the roads are good, and transport demand is high, rural transport operators will tend to use larger-capacity vehicles, which also allows prices to fall.

The RTP is likely to depend on the prevailing transport types, as smaller vehicles generally have higher tariffs per passenger-km. It may also depend on the road section. Busy roads with more competition tend to have lower fares. On many rural roads there are daily, early morning journeys in minibuses, midibuses or even buses to the local towns (and perhaps onward to a city). Once these 'commuter services' have left, there may only be smaller transport services available, such as motorcycles, three-wheelers or utility vehicles. For this reason, to maximise the understanding of how rural communities are affected by transport services, it is best practice to disaggregate the RTP for different vehicle types. It can also be helpful to differentiate between busy and remote road sections, where certain transport types do not serve the remoter villages. If the RTP was entirely or mainly based on the less robust transport services that operate on the more developed sections of the road, this would not take into account the reality for the disadvantaged villagers living near the more remote sections of the road.

A similar indicator can be used for freight tariffs (the ratio of prevailing tariffs to long-distance freight charges). However, this is not such a useful measurement due to the extreme variability of freight tariffs

per tonne-km. These frequently vary in the same rural transport catchment area by 100-fold depending on size of load and distance and may even vary by factors of 1000-fold or more.

2.7.4 Enterprise development

A simple indicator of the development associated with road and transport services provision is the number of enterprises visible along a road. It can be collected with a simple drive along count. If desirable, enterprises can be categorised by type (retail, productive, agricultural), size (turnover, staff) and by the person owning/operating it (gender, ethnicity). Both the simple and the complex forms of the indicator can be used to assess the outcome of investments, as enterprises often develop in response to road investments and transport services. If road databases contain such information, they will help with the evaluation of interventions and assist future prioritisation.

2.8 Rural Access Index

2.8.1 Introduction and resources

Good rural transport services are more likely to develop on roads that are 'all-season'. The Rural Access Index (RAI) uses this premise as an indicator of accessibility for rural communities. The RAI has also been incorporated as SDG 9.1.1 and measures the *proportion of the rural population who live within 2 km of an all-season road* (Roberts et al., 2006). The term 'all-season' as used by the custodian of SDG 9.1.1 (the World Bank) is defined below:

> ***All-season =*** *a road that is motorable all year round by the prevailing means of rural transport (often a pick-up or a truck which does not have four-wheel-drive), with some predictable interruptions of short duration during inclement weather (e.g., heavy rainfall) allowed.*

RAI documentation, advice, guidelines, road map and policy guide can be found on the ReCAP website, notably in Workman and McPherson (2019, 2020a and 2020b). The latest RAI advice, documentation and data can be found on the World Bank and United Nations Data Catalog sites:

https://datacatalog.worldbank.org/dataset/rural-access-index-rai and
https://unstats.un.org/sdgs/metadata/files/Metadata-09-01-01.pdf

2.8.2 Use RAI as part of the planning processes

- Consider using RAI information to help plan local road networks.
  Providing all-season access that is reliable across seasons provides confidence to transport operators that they can invest in a route. Maintaining that road as an all-season road should guarantee that services will continue to operate. An accurate and current RAI measurement can help the planners to identify areas with high population that are not adequately served by an all-season road.

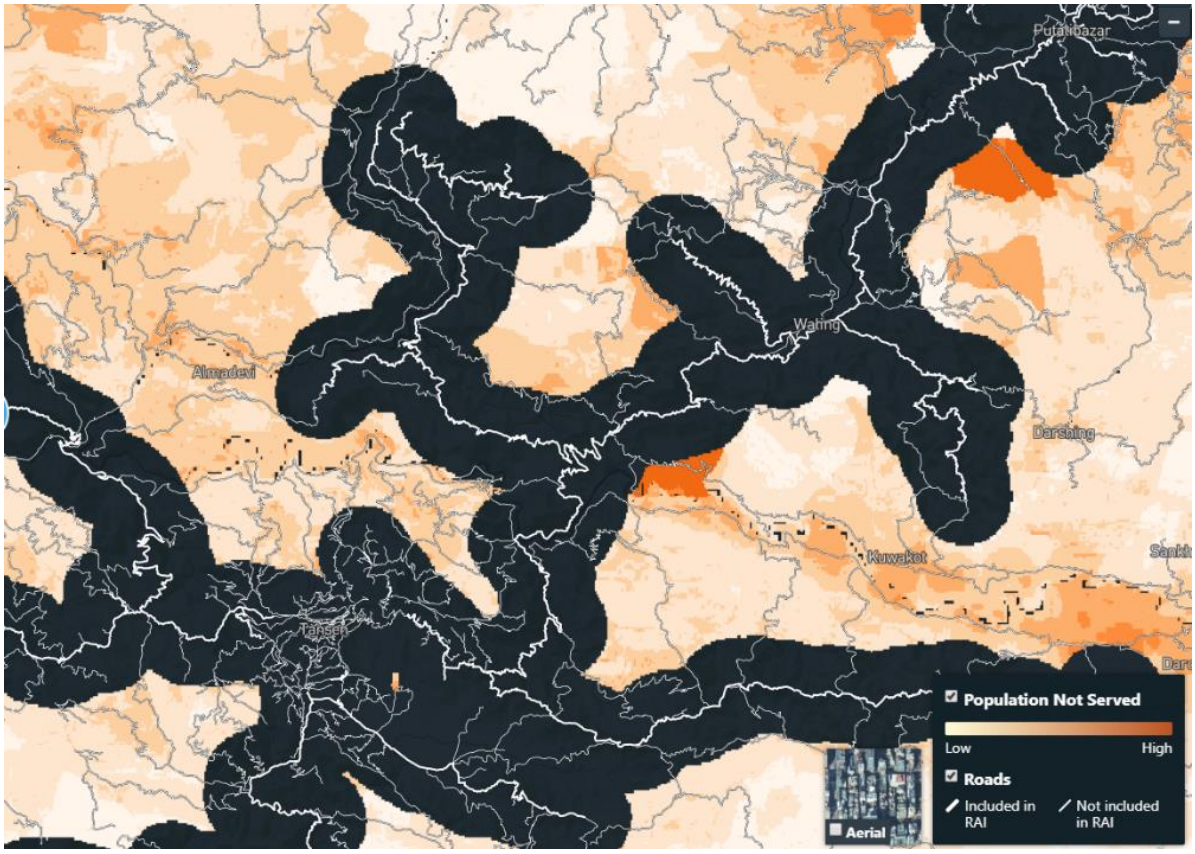
- Make use of RAI mapping to assist planning and identify locations and population with limited rural access.
  A by-product of RAI measurements is mapping that identifies actual locations and populations that have limited rural access, as illustrated in Figure 9. In this figure the all-season roads are shown with a black 2 km buffer, and population distribution is shown in orange, with higher population densities being shown as darker orange. Note that roads without a 2 km buffer are not considered to be all-season and are therefore less likely to develop transport services. Such mapping can be combined with other mapping layers showing locations of health services, education services, market centres and transport services to feed into wider rural development plans and to help ensure that basic accessibility issues are addressed during planning and programming.

- Use RAI at a sub-national level to prioritise road network investments within a country.
  If RAI could be measured at a district or enumeration level it would provide an overview of the accessibility within a country, so districts or administrative areas could be compared. Funds could

then be prioritised on this basis, by investing more upgrading or rehabilitation in areas with lower accessibility. Although RAI could be a good indicator of areas with lower accessibility, it should be noted that substantial work would be required to make any significant improvement in RAI.

- Make use of RAI population data to estimate potential and actual impacts.
  When planning and programming road initiatives, it is easy to use the RAI methodology to identify on maps the actual locations that currently have limited rural access, and to quantify the numbers of people that would be impacted by individual road construction or maintenance initiatives. As works are completed, it will be easier and clearer to demonstrate their impact through absolute reduction in the number of people without access, rather than an increase in RAI.
- Use RAI mapping features to facilitate the identification of areas vulnerable to climate change
  This involves using the RAI 'Accessibility Factors' process developed in the Supplemental Guidelines (see link in 2.8.1 above). This process recommends liaising with local engineers and stakeholders to identify those roads that are not all-season.
- Consider using a secondary RAI value that includes all-season motorcycle trails as well as roads.
  Given the increasing importance of motorcycles for rural mobility, it has been proposed that an optional secondary RAI value may be calculated to show the proportion of the rural populations that are within 2 km of an all-season road or motorcycle trail. Where this data is collected, it will be useful for planning access and assessing the impact motorcycle trails have on rural populations.

Figure 9 Example of RAI calculation map showing population density and all-season roads with a 2 km buffer



It should be noted that the tool used to create this map used open source data for the calculation of the RAI that has not been ratified by governments. The tool can be accessed at https://rai.azavea.com/

3 Design Options for Ensuring Rural Roads are Suitable for Transport Services

3.1 Introduction

All roads authorities have standards and specifications for road construction and maintenance. These vary from country to country due to when and how they were prepared, and to suit the local environment, terrain and available materials. Only a few countries have comparable standards for footpaths, motorcycle trails and trail bridges. It is not the intention of these guidelines to introduce new or different design standards and specifications. Rather, these guidelines will encourage practitioners to consider the role of transport services in rural development and to account for them when planning and designing LVRRs. There is no value in specifying standards that are too expensive or difficult to achieve. The focus of these guidelines is to encourage planners to consider what transport services already exist, and what transport services are likely to develop in the future. Practitioners can then plan and design roads and trails, and their maintenance systems, in the most suitable and economically viable way to allow those transport services to develop sustainably for the benefit of the rural communities.

3.2 Engineering considerations

Some aspects of construction are important to consider for the development of appropriate transport services. Planners should consider the following recommendations.

3.2.1 Surface types

Surface type has an influence on how transport services develop. Planners and designers should consider surface type carefully in order to facilitate appropriate development of transport services. Advice is shown below and issues are summarised in Table 2.

- Provide an all-season road alignment/surface that is motorable all year, apart from exceptional short periods of disruption due to extreme environmental events (see Section 4.8 on the RAI).
  The provision of all-season roads has been shown to be a major determinant in the development of transport services. Roads that have passability issues, especially in the wet season, are less likely to be attractive to transport operators.
- Consider paved surfaces and how they will be constructed.
  Paved surfaces are typically bituminous and concrete sealed surfaces. Most are reliant on heavy machinery, although labour is still an essential component of the construction. Provision of paved surfaces is expensive, and they are less likely to be found on LVRRs. Paved surfaces provide a good running surface for all types of vehicles and should be aspired to if funding is available and maintenance can be regularly and reliably applied. Paved surfaces will allow the unhindered development of transport services, provided that other factors, such as market demand, are also favourable.
- Consider unpaved gravel roads.
  Gravel roads tend to be engineered to a higher standard than earth roads and have more conventional drainage, such as side drains, culverts and drifts. The camber on a gravel road is typically 6%, which is designed to shed rainwater effectively. When a gravel road starts to lose its shape, the surface becomes waterlogged and is vulnerable to damage. Gravel can be crushed or as-dug, with the risk that as-dug material will be less well graded and produce a less smooth and durable surface. On steep sections with no protection the gravel is vulnerable to erosion in the form of longitudinal gullies, which makes it very difficult to traverse for smaller vehicles. The camber on gravel roads must be maintained and surface defects regularly repaired to preserve road condition and keep it accessible to as wide a range of transport services as possible.
- Consider unpaved earth roads.
  Earth roads are complex in the ways they deteriorate, which can make them unpredictable in terms of accessibility for various vehicle types. Their design and specifications need to be flexible and relevant to the local materials and road usage. Labour-based technologies are often most appropriate for earth road construction. Although earth roads do not provide the best riding

quality and the surface is more vulnerable to the environment, the road should be reliably maintained as an all-season road throughout the year so that it can be effectively utilised.

- Pave steep sections so that vehicles can pass during the wet season.
  There are several options for paving steep sections, and the most appropriate will depend on the cost, availability of local materials and capacity to undertake the works. For earth or gravel roads the most appropriate surface may be a cobblestone or stone soling surface that can be produced using locally available materials. These can be long-lasting, but they are rough to drive on, notably for bicycles and motorcycles. Local people can be trained in the skills and techniques for building and maintaining stone sections. Concrete is occasionally used where a smooth surface is essential, but it can be prohibitively expensive, especially in remote areas.
- Avoid parallel concrete strips where possible.
  Concrete strips are used in some countries to provide a durable and cheap alternative to full width surfacing. However, there are issues with this technology that impact on the types of vehicles that are able to use them safely, both from a construction and a maintenance perspective. Concrete strips are not suitable for 3-wheeler use, firstly because the distance between their rear wheels is less than a standard vehicle, and secondly the central gap that is unpaved is often rough or has connectors in concrete between the two main strips. If the unpaved shoulders or central areas are not maintained effectively, they will deteriorate and leave a proud, vertical edge of concrete which is dangerous for bicycles, motorcycles and 3-wheelers.
- Consider the implications for transport services from dust and ride quality.
  Factors such as dust and riding quality can be safety issues and are hindrances to travel comfort and dust can affect people's health and quality of life. However, they are not generally major factors in determining transport service provision. While they should be considered, they should not be given high priority when considering road designs that will facilitate the development of transport services.

Table 2 Considerations for planning rural road surface type suitable for transport services

Surface type	Example	Summary	Impact and recommendations
Paved Bituminous or concrete full-width		Accessible by all vehicles, provided there is sufficient width. Requires more sophisticated and expensive maintenance.	Allows unrestricted development of transport services, but at high cost. * Use where affordable and practical * During design, consider maintenance commitments and capacity to construct to the required standard
Unpaved Gravel		Accessible by most vehicles, less attractive for private cars and three-wheelers, but still accessible if maintained well. Requires more regular maintenance to maintain accessibility standard.	Can slightly restrict some transport, especially if not well maintained. If corrugations develop they can restrict all but heavy vehicles and buses. * Use gravel where higher volumes of heavy trucks and buses are expected. * Maintain the camber on gravel roads to preserve the all-season status
Unpaved Earth		Vulnerable to rainfall, especially if camber is not maintained. Typical defects can restrict the types of vehicle able to ply, for example soft spots, rutting and large potholes.	Transport services are dependent on maintenance standards. Earthen roads are seldom all-season but can be if maintained well and regularly. * Use where traffic volumes are low. * Consider maintenance requirements for wet season, to ensure all-season status is maintained where possible
Cobblestone and stone soling		Provides protection to vulnerable areas, but results in a rough surface, especially for smaller vehicles.	Facilitates all-season access in steep and vulnerable areas, accessible by most vehicles. * Use on steep sections to provide all-season access * Use in areas where surface can become waterlogged
Parallel concrete strips		Provides a cheaper alternative to full-width concrete roads but is harder to maintain and poses problems for motorcycles, three wheelers and other IMTs.	Not suitable for smaller vehicles, especially 2 and 3-wheelers. * Do not use if smaller vehicle access is needed
Block paving		Provides a more durable option for drifts and water crossings than bituminous surfacing, although it is more costly and less available in rural areas.	Good for all types of transport services. * Use at water crossings where possible, given cost and availability constraints * Unlikely to be cost effective for long sections of road

3.2.2 Drainage

Drainage has an important influence on how transport services develop, and how they continue, hence the maintenance of drainage is important. Advice is shown below and issues are summarised in Table 3.

- Provide drainage structures that need minimal maintenance and are robust enough to survive extreme weather events.

  Typically, this involves drifts that can be overtopped during heavy rainfall without blockage or damage to the structure. Culverts require regular cleaning and roads are vulnerable to damage if culverts become blocked. Bridges are essential to traverse major rivers or water courses.

Table 3 Considerations for planning drainage on rural roads

Drainage Type	Example	Summary	Impact and recommendations
Bridge		Essential to provide all-season access at river crossings	If no bridge, some operators will be discouraged from running regular services, especially during the wet season, when some roads would become impassable for days or weeks at a time. * Consider the advantages of bridge provision, the costs and benefits
Culvert		Provides good access across minor water crossings, but vulnerable to blockages and resultant damage. More vulnerable to scouring and washout when used on unpaved roads. Can be difficult and costly to transport heavy concrete pipes to remote areas.	Allows transport services to ply unhindered in accordance with the standard of the road. Needs regular maintenance to avoid damage. * Provide culverts on paved roads, in line with local design guidelines * Carefully consider using on unpaved roads where the risk of blockage and damage is greater
Drift/causeway Vented drift/causeway	 	Provides a robust alternative to culverts, less likely to be damaged in heavy rains. Good option for rural and remote areas on unpaved roads because local materials can be used, no need to haul concrete culvert pipes to remote areas. Gabion boxes and local stone can be used for construction.	Allows all season access, may be restricted access for a few hours during very heavy rains. Surface can be less smooth than the road, but most vehicles can pass. Maintenance is minimal. * Consider using on unpaved roads, especially in hilly areas * Use where there is a high risk that culverts would become blocked or damaged
Ford		No structure, vehicles must essentially drive through the water course, where the riverbed is maintained for access.	Restricts movement of vehicles; buses, trucks, 4WD vehicles and motorcycles can generally pass. * Do not use where all-season access is required to attract appropriate transport services * Where a ford is present, consider installing a drift instead to provide more reliable access
Lined side drains		Most appropriate for use with paved roads. Can be used for unpaved roads but shoulders tend to erode and quickly make the drain ineffective.	Main effect on transport services is the long-term effect on the road surface. * Use with paved roads where possible to ensure the integrity of the road and prevent long-term damage * Use with caution on unpaved roads

Drainage Type	Example	Summary	Impact and recommendations
Earthen side drains		Most appropriate for unpaved roads. Can be used for paved roads but increases the risk of erosion and water penetration into the road structure.	Earthen side drains are integral to unpaved roads and are often used by small vehicles for informal travel if the running carriageway becomes rough. * Use with unpaved roads and maintain in association with main carriageway * Avoid using for paved roads in high rainfall areas

3.2.3 Rural road geometry

The geometry of rural roads influences the choice of transport services, including road width, horizontal and vertical alignments. This will have an influence on road safety. Advice is shown below and issues are summarised in Table 4.

- Design the road geometry, including road width, horizontal and vertical alignment, to be appropriate for the expected transport services,

  Road width should be adequate for the widest predicted vehicles, but roads should not be over-designed if minimal traffic is expected. Passing bays can be used to reduce the overall road width if low traffic is predicted. It may be possible to construct motorcycle tracks or trails where four wheeled vehicles are not expected to develop for some time, but if rapid traffic development is expected it may be more cost effective to construct a full-width road rather than widen an existing track after one or two years.

  Horizontal alignment should be designed to be appropriate for the vehicles expected to use it. Trucks and buses will need wider curves than pickups or tractors. In mountainous terrain different alignments would be required for different vehicles, but if large commercial transport is expected to develop the alignment would need to be designed for that traffic, as re-alignment would likely be prohibitively expensive.

  Vertical alignment should be carefully considered as it affects the types of vehicle able to ply on the road. Vehicles vary in their ability to traverse steep gradients. Light traffic can generally cope better with steeper gradients than heavily laden trucks. Loaded three-wheelers can struggle with steep gradients. Again, in mountainous areas the gradient needs to be fixed for the largest/heaviest vehicles expected, as realignment would be very difficult and expensive.

- Consider road safety and the safe passage for the type of vehicles that are expected to use the road, including issues such as design speed, horizontal and vertical alignment, sight lines and road furniture.

  Due to low speeds and few traffic interactions, design-related road safety issues are not generally major problems on LVRRs, but they must not be ignored. Several ReCAP countries (including Ethiopia, Ghana, Liberia, Mozambique, Myanmar, Sierra Leone, Tanzania and Zambia) have updated manuals for low volume road designs that include road safety considerations that are available on the ReCAP website. Long standing advice on including road safety in road designs was provided by Ross et al. (1991).

Table 4 Considerations for designing the geometry of rural roads

Geometry	Example	Summary	Impact and recommendations
Road width	 	Road authority standards will define maximum and minimum road widths for different classes of road.	Consider road design in light of expected transport services development and the types of vehicles expected. * Ensure adequate width for large vehicles, or sufficient passing points * Ensure adequate width on mountainous roads, especially where wider/longer vehicles are expected * Consider using narrow tracks or trails if only motorcycles are expected
Horizontal alignment		Local design standards will be present for the horizontal alignments of rural roads. Design speed of a road should be appropriate for the types of vehicles expected to use it.	Transport services can be limited by the horizontal alignment of a road, especially in hilly terrain. * Consider the longest/widest vehicles likely to use the road in the future, and design the horizontal alignment appropriately * Consider road safety in horizontal design, especially for smaller vehicles * Use informational and warning signs where road alignment may pose a risk to safety
Vertical alignment	 	Local design standards will be present for the vertical alignments of rural roads. Landslides are a potential hazard for transport services in many countries. Road construction can minimise this risk if carried out appropriately, using technologies such as cut-and-fill and bio-engineering.	Some transport services will be dependent on the vertical alignment of a road, especially where steep sections are likely to be slippery. * Design roads carefully to avoid overly steep areas for the type of vehicles expected, if possible * Use appropriate technologies to stabilise roadside slopes *Consider road safety, especially in mountainous areas * Use informational and warning signs where road alignment may pose a risk to safety

3.2.4 Motorcycle trails and trail bridges

- Consider constructing specific tracks or trails for motorcycles and other smaller vehicles.
  Motorcycle tracks or trails are an option to connect communities to an all-season road, as motorcycles can traverse rougher terrain than four-wheeled vehicles (SuM4All, 2019; Workman and McPherson, 2019). This type of infrastructure can be narrower with less structural strength than standard gravel or earth roads, greatly reducing the cost of connectivity. Motorcycle trails can be earth paths cleared by villagers or can be engineered to ensure effective drainage. Surface construction can be earth, gravel, brick, stone or concrete. If it is expected that the track or trail will need to be upgraded to a rural road standard within one or two years, it may be more cost effective for the local road authority to construct a road in the first place.

Figure 10 Examples of constructed motorcycle trails

Countries (L-R): Liberia, Myanmar, Bangladesh, Indonesia

- Consider policies and strategies that would enable off-road villages to be connected to the rural road network by motorcycle trails and trail bridges

  Now that motorcycles are often the most common vehicle in rural areas, the construction of motorcycle trails appears a valuable and inexpensive approach to improving rural mobility.

- Consider constructing specific trail bridges suitable for pedestrians, motorcycles and other small IMTs.

  Where there are large water crossings villagers themselves may not be able to construct bridges. Simple trail bridges can traverse water crossings and are inexpensive compared to road bridges. In some countries such as Nepal, rural roads authorities have specialist trail bridge units to provide engineering advice that allows local community-based organisations to construct trail bridges.

Figure 11 Examples of trail bridges useable by pedestrians and motorcycles

Countries (L-R): Haiti, Nicaragua, Nepal, Burundi, Liberia

4 LVRR Maintenance Options that are Suitable for Transport Services

The overwhelming need for the development of transport services is a reliably accessible road network. Private transport operators require all-season roads with reliable access for their vehicles to invest in running a transport service on a route. Maintenance of roads is vital to sustain the required standards of road serviceability and all-season access, and this maintenance must be visible, reliable and consistent.

There are a number of maintenance activities that are essential for preserving the condition of roads to an adequate level of passability and to the standards required to sustain appropriate transport services. References are provided to relevant sections in the International Road Maintenance Handbooks (IRMH), that were developed by PIARC, DFID and TRL (PIARC, 1994a and 1994b, 2006a and 2006b).

- Plan and implement routine maintenance on a regular basis to sustain appropriate transport services:

  For earth and gravel roads routine maintenance consists of basic activities that can be carried out by semi-skilled labour using basic hand tools, either by a lengthworker type system or small maintenance gangs. Typically, this includes activities such as grass cutting, clearing drains, managing vegetation at the sides of the road and filling minor depressions and potholes with locally available material (but without mechanical compaction). These activities should be carried out regularly to prevent deterioration of the road surface, especially during the wet season. It is recommended that numbers of routine maintenance workers are increased during the rainy season in order to cope with the increased workload and minimise the need for more intense maintenance activities. Typical routine maintenance activities are covered in IRMH, Vol. 1 (PIARC, 1994a); Maintenance of roadside areas, with the labour-based patching being covered under IRMH, Vol. 2, pp 105 (PIARC, 1994b).

  For paved roads, the types of defect will be different and routine maintenance by lengthworkers will not include repair of the surface, as specialist materials and equipment are necessary for this activity. Labourers can however keep drainage clear and functioning and clean the surface of the road, as well as preventing any hazards. IRMH, Vol 3: Maintenance of Paved Roads (PIARC, 2006a) provides an overview of the defects to be expected and methods of routine maintenance.

- Carry out patching on unpaved roads to maintain riding quality and prevent further deterioration.

  The terminology for patching of unpaved roads varies between countries, but generally includes the repair of unpaved surfaces beyond the routine small pothole or depression filling that can be undertaken manually by lengthworkers, but without reshaping the road surface. This would typically be carried out using imported gravel and mechanical compaction. The maintenance worker will clean out and cut square the affected area, fill with new gravel and compact (IRMH, Vol. 2; pp 83 in PIARC, 1994b). Patching on paved roads is covered in IRMH, Vol 3: pp 67 (PIARC, 2006a).

- Carry out spot regravelling on unpaved roads to maintain passability, but do not over-rely on it as a method of road maintenance because without a long-term maintenance plan the road will become more expensive to maintain and riding quality will continue to deteriorate.

  Larger deteriorated areas can be repaired in a similar way as for patching but will need imported material and mechanical compaction to be effective; in this instance this is referred to as spot regravelling. When a short section of road has deteriorated to the extent that it has lost its shape and routine maintenance is no longer effective, it will be necessary to carry out regravelling, with reshaping and mechanical compaction. Heavy machinery will most likely be required and this is referred to as spot regravelling or spot improvement in this instance (IRMH, Vol. 2; pp 115 in PIARC, 1994b).

- Consider planning periodic maintenance throughout the life of the road.

  Periodic maintenance is defined as maintenance operations that are occasionally required on a section of road after a number of years. They are typically large scale and would normally require specialist equipment and skilled resources, although it is possible to implement some periodic maintenance using labour-based resources. These operations are expensive and require specific

identification and planning. For unpaved roads this would involve the regravelling of a road or sections of a road, and reshaping, ensuring that an adequate camber is restored. Periodic maintenance for unpaved roads is covered in IRMH, Vol. 2 (PIARC, 1994b).

On paved roads periodic maintenance would include resurfacing or patching and additional overlays, which are covered in IRMH, Vol. 3 (PIARC, 2006a).

- Ensure that drainage is given high priority when maintaining both unpaved and paved roads.
  Water is recognised as the main impediment for roads, especially unpaved roads where the risk of water ingress into the structure of the road is much higher. Simple routine maintenance to keep drains and culverts clear of debris can be very effective in preventing damage that would occur from blocked drainage. It is also important to regularly inspect drainage to identify defects, so that they can be repaired in a timely manner and prevent further damage.

5 Options for Improving Rural Transport Services

5.1 Context and overview of options

The options discussed in this section should be considered in light of the devolved planning mechanisms and participatory processes described in Section 2. Prior to reaching this stage, it is likely that there will have been national-level discussions involving the relevant ministries, transport services authorities and rural roads authorities to develop a framework of cooperation and to agree a strategy to be implemented at devolved levels. The strategy is then likely to be piloted in a few selected districts and the lessons gained from these pilots can be shared with the districts that will implement the subsequent initiatives. Some of the options contained in this section could be selected (through local discussions) for local testing and implementation. One key mechanism will be working with and through operator associations in close discussion with local focus groups of transport users living along the roads surveyed.

5.2 Work with operator associations at a devolved level

- If there are national associations, hold discussions with the associations to inform them of the need to work with local stakeholders at the devolved level.

  For courtesy and transparency, representatives of national associations should be contacted to inform them of the devolved processes. Any role the national body may have can be discussed, but it should be stressed that the planning and decision making must be carried out at a local level with representatives of the local operators that they themselves will have faith in.

- Contact operators' associations and/or ask rural transport operators to nominate eloquent spokespersons that they trust.

  Even at the devolved district level, it is difficult for planning authorities to work directly with individual, informal sector transport services operators. There may be several hundred operating with a district, and many may not have completed secondary education.

- Work with these people checking that members have confidence in them.
- Be aware that some officials of transport associations may not be representative of the operators and may be involved in rent-seeking manipulation of the associations.
- Involve all types of transport services but decide (with the different associations) whether it is better to have joint discussions or separate discussions with different associations.

  In some circumstances different means of transport are complementary, offering different types of service (e.g. buses and three-wheelers). These may be happy to work on joint planning. In other circumstances, different types of vehicles see others as competitors (e.g. buses and jeeps) and may not wish to work together. Joint planning is preferable, provided relationships are constructive and no association partner feels marginalised by the planning discussions.

- Concentrate discussions on options for improving transport services.
- Do not get bogged down in administrative arrangements: planning of appropriate institutional modalities can follow once there is clear interest to work together.
- Where there are powerful associations or cartels, try to work with these but be aware of vested interests and of competing and conflicting interests.
- Ascertain and map the current routes, frequencies, markets served, operational systems and tariffs, in consultation with the various associations. Record and map the roads and villages that are served and those that are not served.
- Verify the information gained from transport services operators with local residents, in the context of the operator meetings (with representatives of villages) or at separate meetings along the roads in question. During such meetings, or as part of the planning processes discussed in Section 2, ensure that the planners and the operators are fully aware of the key destinations to which villagers wish to travel, and whether or not the existing transport services provide appropriate transport services to allow this.

It is usually straightforward to obtain consensus on current practices by comparing what operators say and what villagers say and investigating discrepancies. Be aware that actual practices may differ from those approved by regulators, in terms of tariffs, routes and operational practices. An atmosphere of trust needs to be established to allow honest discussions without fear of future sanctions.

- For routes (roads, tracks, trails) that are served and those not served, identify the key factors that limit service provision in order of priority for the transport services (factors may include market demand, condition of the infrastructure, security, competition or regulatory issues, such as check points or price capping).
  At this stage, the core information should have been obtained to understand and to map the existing local transport services provision highlighting roads/routes with no services and those with poor transport services. The conditions that limit the existing transport services should also be understood, and may include market demand, provision and maintenance of infrastructure, issues of competition, regulation and self-regulation and other issues.
- With the transport services, start to discuss the various options for improving service provision, as discussed in Section 5.4.

5.3 Consider subsidies for rural transport services

- At national and devolved levels consider the options for various subsidies prior to and during discussions with rural transport services operators.
  Rural roads are heavily subsidised, with the costs of their provision and maintenance being paid from public funds and few direct charges to users, and indirect charges being shared by all road users through road fund contributions. In high income countries, rural transport services are heavily subsidised, and urban transport services are subsidised in a wide range of countries. There are many precedents and justifications for subsidising rural transport services, including the 'right to transport' and the aim to 'leave no one behind'.
- Consider the role of parastatal bus enterprises.
  Where there are parastatal bus companies, these tend to provide urban and interurban services. They rarely provide small-scale village-to-market town transport. The option to instruct parastatal companies to have district-level operations to provide village connectivity on LVRRs should be considered. The implications for all parties of subsidised parastatals competing with private sector services should be discussed.
- Consider fuel subsidies.
  Fuel subsidies are often provided at times of rising international oil prices and are one mechanism for supporting rural transport. Subsidy delivery mechanisms to the informal private sector can be problematic. Fuel subsidies can be offered to all operators to those willing to serve specific routes. They can also be offered in return for agreements to reduce fares for children and special groups such as people with disabilities. Once fuel subsidies are introduced, it can be difficult to disengage from the scheme.
- Consider fiscal subsidies, including customs tariffs and vehicle taxation.
  Reducing customs tariffs and/or VAT on imported vehicles and spare parts are ways of encouraging and facilitating fleet renewal. Many transport service vehicles are bought second hand although motorcycles and three-wheelers are often purchased new. The mobility of vehicles between locations makes it difficult to target fiscal subsidies on rural transport services. Subsidising particular vehicle models can distort decision-making choices for operators. Allowing transport services to operate without paying an annual road tax is a relatively simple subsidy (that some operators already take, albeit without permission).
- Consider route subsidies.
  In many high-income countries, transport operators bid to operate rural routes, tendering for the amount of subsidy they require. If funds are available, this principle could be implemented at

district level in low- and middle-income countries. Prior to the formalisation of the rural transport sector, this could present administrative problems for the various actors. Bus companies operating inter-urban routes could compete for such subsidies, preferably in collaboration with existing district level operators.

- Consider route cross subsidies.
  The condition of route licences for profitable intercity routes could be altered (with adequate warning and discussion) to make them conditional on the provision of some complementary district level feeder services and/or some route alterations (on a certain percentage of runs) so that some of the existing services deviate to pass though specific villages. Provided the inter-urban routes are profitable, the operators should be willing to undertake these additional services. However, given that the operator is being forced through route regulation to provide the cross-subsidised services, this mechanism is unlikely to be popular with existing operators.

- Consider capital or credit subsidies for fleet acquisition and renewal.
  Rural transport services operators have little capital and so tend to use old, cheap vehicles, which may be of inferior standard compared to newer vehicles. Motorcycle and three-wheeler operators use newer vehicles, often because they have access to daily leasing arrangements or hire purchase schemes. Banks are often reluctant to give loans for the purchase of larger vehicles unless there is valuable collateral, which many rural transport operators lack. As part of initiatives to improve local transport quality and safety, credit schemes could be set up in association with local financial services. The subsidy element could be through guaranteeing the loans, low interest rates and/or reduced capital costs.

- Consider fare subsidies for children and disadvantaged groups.
  In many countries, children and disadvantaged groups, such as people with disabilities and older persons, pay reduced fares, and sometimes travel free. This is sometimes a regulatory requirement, but in many countries operators provide reductions because they consider this appropriate. In some countries there are subsidies to compensate for fare concessions. These are generally flat-rate and not based on actual ridership of concession passengers.

- Consider short-term 'seeding' subsidies and 'pump-priming' to encourage operators to adopt new practices. These subsidies are particularly appropriate for pilot initiatives as they can motivate operators to make changes and can be easily phased out.
  Short-term funding can be made available during district-based pilot initiatives to assist operators to modify their vehicles, their operational procedures (schedules, loading levels) and/or their organisation (self-regulation, formalising their associations, introduction of demand-consolidating apps, providing emergency medical transport). For example, grants can be given to improve safety features. Trip based allowances can be provided to encourage operators to increase market demand by introducing more frequent 'timetabled' services.

- Discuss with operators the possibilities of subsidies (if these may be approved) and learn what the operators consider would be their priorities, their benefits, any disbenefits and how a subsidy might be implemented.

5.4 Identify and encourage market demand

In all rural areas there is some need for transport services to allow people without their own means of transport to travel to shops, markets, medical facilities, educational establishments, work and socio-economic opportunities. The demand may vary by people's gender, age and ability, and also by time of day, day of the week and season of the year. In rural areas, there is generally high demand on market days and much lower demand on other days. As part of the district-level planning processes (discussed in Section 2), information should be gathered to ascertain people's travel needs. It is not sufficient to undertake origin and destination surveys of existing transport users, as these do not measure the demand that is not being met due to inadequate transport services. Focus group discussions with villagers and operators can help identify the unmet demand, and ways in which this could be met. Options may include improving existing

service frequency and predictability, consolidating demand in time and/or space, adjusting routes, changing vehicle types, and ensuring emergency medical transport.

5.4.1 Improve service frequency and predictability

- Discuss with transport operators ways to increase their service frequency and predictability and reduce times passengers have to wait.

  Long waiting times can lead to a negative spiral of reduced ridership causing even worse frequency. Shorter waiting times can generate a positive spiral of more people deciding to travel and increased service supply. Increasing service frequency and predictability may increase market demand with potential benefits for operators and transport users.

- Discuss with transport operators if they could introduce simple timetables and what incentives would be needed to start this.

  On some shared routes, operators agree to depart as soon as they are full, or after (say) 15 minutes at peak times if not full, and after (say) 30 minutes at non-peak times if not full. This leads to higher frequency and greater predictability and increases market demand. The increase in demand may be gradual. Operators used to always travelling with a full load, may need an incentive (income guarantee or subsidy) to start to trial the process. They may need assurance that while they make less money per trip, with more trips a week, their overall earnings should be higher.

- Discuss with operators if complementary vehicle types could operate the same route to increase service frequency, predictability and transport demand.

  On routes where off-peak demand is insufficient to justify large vehicles (buses, midibuses or minibuses) the route can be shared by smaller vehicles, such as saloon rural taxis or three-wheelers. Transport services operators are often worried by competition, and may require encouragement (community requests, regulatory assurances, incentives) to accept route sharing.

5.4.2 Consolidate demand

- Where transport demand appears low, discuss with operators and users how the existing demand could be consolidated in time and space. Consider village-based minimum demand/income agreements, inter-village demand agreements and ride-sharing apps (see Section 5.4.5).

  Where there is some transport demand but no transport services supply, discussions can be facilitated between potential operators and villagers to agree that a minimum number of 'tickets' will be bought each day. This could be ten daily passengers to justify a minibus service and ensure operating costs are met. All additional passengers will represent profit for the operator. Options could include someone in the village selling tickets, village-level agreements (or a pilot project) to guarantee a minimum income for the operator. Closely located villages could agree on a single convenient terminal or bus stop to which people from several villages would walk to ensure enough passengers to justify service provision.

5.4.3 Plan more comprehensive routes and consider introducing route sharing

- With operators and users map existing routes and identify roads with few or no transport services.
- Discuss, with operators and users, possibilities for creating new routes and/or adjusting existing routes to cover poorly serviced routes.

  Where several operators share a route with surplus vehicle supply (which is often the case and leads to few trips per day per operator), they may agree to serve an additional, less profitable route, keeping to a rota. While profits per trip from the additional route may not be a good as those on the existing route, taking on the extra shared route will increase overall trips per week and lead to greater weekly income.

5.4.4 Hub and spoke complementarity

- Examine, with operators, road and route maps and highlight existing transport hubs, including district-town hubs and inter-urban provincial hubs. Highlight smaller feeder hubs, such as road

junctions where smaller vehicles (rural taxis, three-wheelers, motorcycle taxis) provide shuttle services to and from villages. With users and operators, consider adjusting the routes, to encourage greater hub-and-spoke complementarity, with larger-capacity vehicles concentrating on longer, main routes and smaller vehicles bringing people to and from villages to the high-capacity routes.

While transport services already use hub-and-spoke models, these can be improved through careful participative planning. This can benefit all parties, as small vehicles provide frequent shuttle services, enabling increasing ridership of the larger vehicles that operate along transport corridors. As motorcycle taxis can travel along paths and trails to off-road villages, these can be part of the complementary hub and spoke systems (in countries where they are used).

5.4.5 Consider increased use of telecommunications, ride-sharing apps and electronic ticketing

- Discuss with operators and users greater use of electronic technologies to increase and consolidate market demand. Consider systems to allow ridesharing and ensuring sufficient demand to justify a transport services trip.

  Mobile phones are now widely available in rural areas and are already used to meet individual transport demand for point-to-point taxi services. They can also be used by transport associations (or other organisations) to consolidate market demand and justify public transport trips. The need for public transport can be logged and vehicles dispatched when there is sufficient demand. A simple telephone system requires minimal capital and personnel resource to set up. A phone app requires more resources to establish but can be replicated in many districts. In the medium term, electronic ticketing provides numerous advantages to all stakeholders.

5.4.6 Facilitate emergency medical transport

- Discuss with operators and users the present systems for emergency medical transport. Where these are inadequate, consider schemes to facilitate transport services operators to provide such services and the implications in terms of training, organisation and incentives.

  An example could be a system set up in Nigeria in cooperation with an operators' association to enable taxi drivers to respond to requests to carry pregnant women to childbirth facilities. They only receive the cost of their fuel but benefit from jumping to the head of the taxi queue.

5.5 Improve the quality, safety, accessibility and compliance of transport services

- Discuss with operators and transport user options for improving vehicle quality, safety, accessibility, loading levels, vehicle and passenger insurance and issues of compliance and enforcement. Prioritise the key issues for passengers and for operators. Plan ways of improving standards and how these can be realistically implemented over a reasonable timescale, with attention to any incentives or sanctions required and mutually acceptable means of enforcement.

  Rural transport services are notorious for using sub-standard vehicles and failing to comply with national regulations on loading levels. In most countries there are clear legal frameworks and means of enforcement that could, in theory, be applied immediately. In practice, this does not happen. Where there are clampdowns, they tend to be short lived and may lead to fewer transport services. This demonstrates that local situations are complicated and require a different approach. Working with and through transport associations and gradually improving standards appears a realistic option, provided there are participative processes, some incentives and some sanctions that operators consider reasonable. The aim should be to work with associations to raise standards (while maintaining and/or increasing transport services) through operator training, association self-regulation and incentive schemes.

5.6 Formalising rural transport services

- Discuss with transport services operators options for formalising their associations and developing cooperative societies or mutually-owned companies. While the prospect of this can be mentioned early on in the planning discussions, attempts to move forward on this should be left until progress

has been made on understanding the current situation and ways of improving rural transport services.

Many governments and authorities would like to see self-employed, informal sector operators consolidated into legal entities, whether cooperative societies or formal sector companies. This can be achieved, but it is likely to take several years. The processes are quite vulnerable to excessive bureaucracy, vested interests and lack of commitment. The idea of using a new organisational structure to implement pilot initiatives would seem attractive but achieving this could delay progress in improving rural transport services. It is recommended that progress is first made on building trust and implementing some pilot initiatives. This should provide a good foundation for subsequent institutional changes.

6 Way Forward and Available Resources

6.1 Pilot multidisciplinary district-level planning for roads, trails and transport services

It is hoped that roads and transport services authorities, as well as donor-supported project initiatives will use these guidelines to plan appropriate infrastructure with improved transport services. It is suggested that pilot district-level initiatives be undertaken in the first instance, to gain experience and lessons prior to subsequent wider replication. The authors and the commissioning organisation (ReCAP) would appreciate feedback. It is hoped that the lessons gained from experiences can be shared (whatever the results).

For the ministries responsible for roads and transport services, the following sequence of activities might be undertaken.

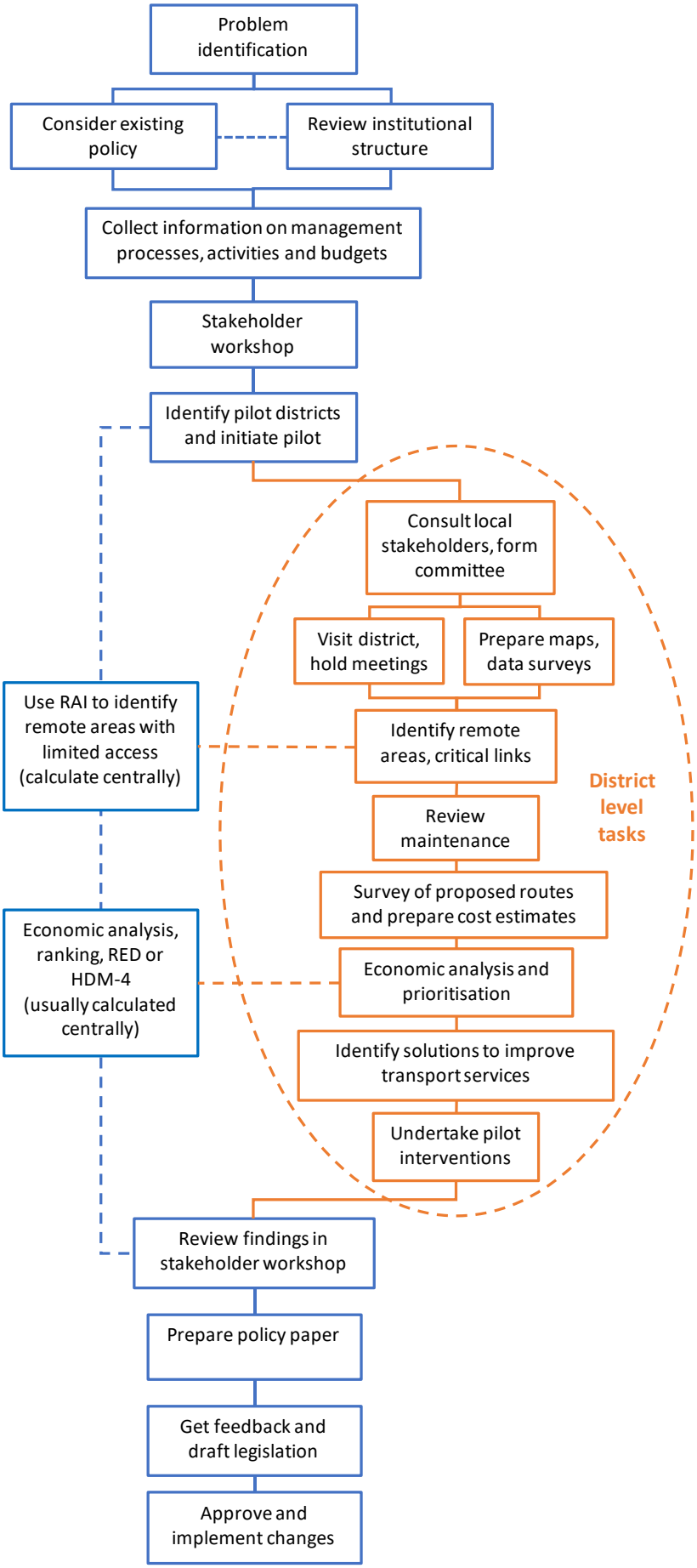
1. Problem Identification: review of existing data on road and population density, RAI, fares, tariffs, traffic volumes, access to markets, clinics and schools.
2. Consider stated government policy, identify priorities, refine objectives.
3. Review institutional structure for management of rural transport services and rural roads.
4. Collect information on management processes, activities undertaken and available budgets.
5. Hold an initial 'stakeholder workshop' and mobilise support, from government and donors for initial studies, pilot interventions and further action.
6. Identify pilot districts for detailed examination. Prepare terms of reference for officials /and or consultants to undertake initial pilot district work.

   In Pilot Districts:

   a. Consult with district officials, road engineers and transporters, identify critical transport issues facing the district.
   b. Visit different parts of district, hold village level meetings.
   c. Prepare maps and mount surveys.
   d. Identify remote locations and critical links with high fares and/or seasonal impassability.
   e. Review data from maintenance management systems and identify most cost-effective infrastructure interventions.
   f. Identify most suitable solutions for improving transport services.
   g. Undertake pilot interventions monitored by consultants.
7. Following the pilot district studies, review findings in a stakeholder workshop.
8. Prepare a policy paper can be presented to cabinet and adopted as government policy.
9. Changes in legislation can be drafted and presented to cabinet and parliament.
10. Plan and implement institutional changes in regulatory and service organisations and associated changes in public budgets.

The various processes are illustrated in Figure 12.

Figure 12 Schematic flow diagram summarising key steps in the adoption of an integrated approach



In addition to these guidelines, there are useful lessons contained in the other IMPARTS outputs including the scoping report with its literature review and consultations (Starkey et al., 2019a), the report of research in Nepal (Starkey et al., 2020b), research in Tanzania (Starkey et al., 2020c) research on options to improve transport services (Starkey and Hine, 2020) and the Final Report (Starkey et al., 2020d). There are also many valuable resources freely available to download from secure websites.

6.2 Consult resources relating to rural access and its impact

The ReCAP resource library contains many documents relating to rural access, LVRRs, transport services and road safety. This includes resources developed by the South East Asia Community Access Programme (SEACAP). http://www.research4cap.org/SitePages/Rural access library.aspx

The SSATP website contains several influential publications relating to rural infrastructure, planning and transport services, several of which have been cited here: https://www.ssatp.org/publications

The Asian Development Bank (ADB) also has many valuable publications including some important studies on infrastructure, transport services, impacts of roads and road safety: https://www.adb.org/publications

The SuM4All website contains the *Global Roadmap of Action Toward Sustainable Mobility* and relevant policy papers relating to universal rural access, gender and road safety: http://sum4all.org/gra

There have been numerous studies on the impact of rural infrastructure, and recent reviews of these include Starkey and Hine (2014), Hine et al. (2016) and Hine et al. (2018), which cite many other information sources.

6.3 Consult resources relating to infrastructure provision and maintenance

The principles of rural road construction are similar for most countries, but inevitably there are differences as most countries have now developed their own construction standards and specifications to suit the local situations. However, there are still freely accessible documents that can provide generic guidance on construction standards for rural roads. These include:

- The ReCAP Rural Road Note (Rolt et al., 2020)
- The SEACAP LVRR standards (SEACAP 2008a-c) are available on the ReCAP website.
- The TRL Overseas Road Notes (ORN) are available on the TRL website: https://trl.co.uk/
  ORN6: A guide to geometric design
  ORN9: A design manual for small bridges
  ORN16: Principles of low cost road engineering in mountainous regions
  ORN22: A guide to pro-poor transport appraisal
  ORN31: A guide to the structural design of bitumen-surfaced roads in tropical and sub-tropical countries
- The TRL Guide: Towards safer roads in developing countries; a guide for planners and engineers (Ross et al., 1991)
- Otta Seal is a low cost surfacing that is appropriate for rural roads. The Otta Seal Surfacing guide can be found at: https://www.ssatp.org/sites/ssatp/files/publications/HTML/LVSR/English/Added-2007/2007-Otta-Seal-Guide-by-ChOverby-MPinard.pdf

Every country has its own standards and specifications for road maintenance, so if specific guidance is required for a particular country or region then the local regulations should be sourced; they are too numerous to mention here. However, if general guidance is required on the types of maintenance and resources required to carry out maintenance, there are several international resources that can be accessed without charge:

- The PIARC International Road Maintenance Handbook series, Volumes I to IV, would be appropriate and these are available on the ReCAP website:

  Volume I: Maintenance of roadside areas and drainage (PIARC, 1994a)
  Volume II: Maintenance of unpaved roads (PIARC, 1994b)

Volume III: Maintenance of paved roads (PIARC, 2006a)
Volume IV: Maintenance of structures and traffic control devices (PIARC, 2006b)

- The TRL *https://trl.co.uk/* ORN series have several guides to road maintenance, including:
  ORN1: Road maintenance management for district engineers
  ORN2: Maintenance techniques for district engineers
  ORN20: Management of rural road networks

Motorcycle trails vary greatly within and between countries and roads authorities generally do not have specific standards to follow. However, further information on motorcycle trails and their impact can be found in SuM4All (2019); Jenkins and Peters (2016), and Peters et al (2018).

In contrast, detailed specifications and standards exist for suspended and suspension trail bridges, including manuals produced for the Government of Nepal with the cooperation of the NGO Helvetas. Further details on trail bridges can be obtained from Helvetas https://www.helvetas.org/en/switzerland and the NGO Bridges for Prosperity https://bridgestoprosperity.org/. Simpler trail bridge designs are available from IT Transport (2004).

6.4 Consult resources relating to infrastructure planning and transport services

Two reports that discuss and compare a range of road planning techniques including RED and HDM-4 are Hine (2014) and Rolt et al (2020). General information on the RED model is available from World Bank (2006). A good source of information on a 'basic access' approach is given in Lebo and Schelling (2001).

6.5 Consult resources relating to transport services

Various publications relating to transport services are available on the ReCAP website, including several relating to motorcycles, motorcycle taxis and safety, and operator associations (Bishop and Amos, 2015; Bishop et al, 2019). The ReCAP website and the Transaid website (http://www.transaid.org/) also have publications relating to safety, transport associations, training and collaboration with transport associations to provide emergency medical services (Transaid, 2013, 2014 and 2015).

An overview of motorcycle taxi uses was provided by Starkey (2016a), and an overview of rural transport services and their operational practices is available in Starkey (2016b). A report relating to three-wheelers for rural transport services in Pakistan is also available (Starkey et al., 2020a).

Examples of using maps to understand the operations of transport services were provided in the report of the IMPARTS research in Tanzania (Starkey et al., 2020c) and in the paper by Afukaar et al. (2019).

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Annex 1 Understanding Rural Transport Services

1. Introductory note

This annex is intended to summarise some key attributes of transport services to assist understanding of the subsequent guidelines concerning planning rural transport infrastructure that is 'fit for purpose' and improving rural transport services. It builds on the various IMPARTS reports as well as numerous other documents. However, to enhance the readability of the following paragraphs, specific references are not cited here. Further information, with references can be found in Hine, 2014; Hine et al., 2016; Starkey, 2016a and 2016b; Starkey et al., 2019a; 2020a, 2020b, 2020c and 2020d.

2. Importance of roads and transport services for rural communities

Many studies have demonstrated beneficial correlations between road investments and socio-economic development. Roads can lead to higher agricultural production, higher attendance at schools and health facilities and more economically important trips. However, very few of these studies have reported on transport services, relying on socio-economic, GIS or other data sources for their correlated outcomes.

Transport services are essential for rural mobility in low-income countries with low vehicle ownership. A common assumption of road investment proposals is that rural mobility will be enhanced as transport services respond to road improvements by reducing tariffs (lower vehicle operating costs) and improving vehicle capacities/frequencies. Evidence is scarce as few rural road initiatives have baseline and post-investment datasets related to transport services. Few roads authorities use transport services information (other than that which can be inferred from traffic counts) in prioritising investments.

Within rural communities, individuals are diverse, with different transport needs to access markets, healthcare, education, livelihood opportunities and other facilities. Men and women, children, older persons and people with disabilities may have different travel priorities and needs. They may also have differences in their access to funds for travel, their ability to climb into vehicles, their willingness to travel under crowded conditions and their perceptions of what constitutes safe and affordable transport.

3. Types of 'conventional' transport services

There is a wide range of transport services vehicles including buses, midibuses, minibuses, minivans, taxis, jeeps, pickups, passenger trucks, three-wheelers and motorcycles. All of these have different passenger capacities, levels of comfort, ground clearance, robustness and ability to pass through muddy, slippery, sandy, rocky or steep sections of a road. They also differ greatly in their purchase cost (new or second hand), their fuel consumption and their operating costs. These cost differences and the number of passengers likely to be carried will greatly influence the fares that they need to charge to break even and to make a profit.

Large vehicles that can carry many passengers, such as buses and large passenger trucks, are generally able to offer low fares, due to their economy of scale, provided they can travel long distances with large numbers of passengers. However, these are the most expensive vehicles, and require significant capital, making it difficult for small, informal sector operators to buy them. More importantly, they are not profitable if they only carry small numbers of passengers and operate on short routes. Since many village-to-town LVRRs are quite short and have low transport demand, large buses and passenger trucks are not common on such roads, but they may operate long routes that start in villages and go onto large towns often passing along national or provincial/regional roads for much of their route. Older designs of buses generally have high clearance which makes access difficult but allows buses to travel on rough roads. Buses have problems with slippery gradients and deep sand. Where roads are very rough and where there are hairpin bends, passenger trucks and short-chassis buses have advantages over long-chassis buses.

Figure 13 A long chassis bus, a short chassis bus and a passenger truck

Countries (L-R): Tanzania, Nepal, Myanmar

For linking small villages to market towns, rural taxis may be saloon or estate cars (with official capacities of four passengers, but many more may be crammed in where there is minimal enforcement). For rough roads, jeeps and pickups may be used, although these are more expensive vehicles with higher operating costs and consequently higher fares. Enclosed pickups with sideways-facing seats sometimes carry 10-12 passengers with space for market goods between the passengers in the rear. If the roads are quite good, minivans, which are relatively cheap vehicles to buy, have about 6-8 passenger seats and minibuses have 14-18 seats. Apart from road quality, whether minibuses are viable will depend on the market demand. If there is low market demand, it may take a long time for 16 passengers to arrive, and long-waiting times discourage people from travelling, leading to a descending spiral of transport supply and demand. Where there is a good market appropriate for minibuses, further economies of scale may be achieved using midibuses, with 25-35 seats.

Figure 14 Examples of a rural taxi, pickup/jeep, minibus and midibus used on LVRRs

Countries (L-R): Liberia, Nepal, Tanzania, Pakistan

4. Three-wheelers, motorcycles, motorcycle taxis and other IMTs

There are two main types of three-wheelers used on rural roads. Scooter-based autorickshaws, which the Indian Bajaj brand made popular in the 1950s as small urban taxis, are increasingly used in rural areas. Some are used as three-seat point-to-point taxis, but others operate along rural routes and generally seat six passengers. More recently, motorcycle three-wheelers have been developed, and models originally intended as small freight pickups can be fitted with sideways facing seats, designed to carry 10 passengers. These generally operate route-based services. They are much cheaper to buy and to run than four-wheel vehicles of similar passenger capacity. While they are not good on sandy or muddy roads, motorcycle three-wheelers are light weight and so can be lifted out of problems more easily than can heavier utility vehicles. In many countries, three-wheelers are increasingly being used for small-scale rural transport services.

Figure 15 An autorickshaw and motorcycle three-wheelers supplying route-based services

Countries (L-R): Tanzania, Ethiopia and Myanmar

While three-wheelers are increasing, their numbers are small compared to motorcycles that have seen exponential growth in many low- and medium-income countries in the past 20-30 thirty years. In many countries, motorcycles are now the most common vehicles on LVRRs, and as such, it is necessary to consider them in the planning of rural infrastructure. Most motorcycles are owned by individuals for the mobility of themselves and their families. On LVRRs in many countries, it is not unusual to see families travelling together on one motorcycle, even though in most countries the legal limit is a driver and one passenger. Motorcycles have numerous advantages for rural mobility: they are inexpensive to run and the cheapest motorised transport to buy (although beyond the reach of most rural poor people). The driver is in control, with no dependency on transport services in terms of the time of travel and the destination. On rough rural roads with potholes, they have another advantage in that they can often travel faster than 4-wheel vehicles, by meandering around problems. Where there is a fallen tree, landslide or patch of deep mud, motorcycles can often find a way round or be carried over the obstruction. They can also travel off the road along paths and trails, allowing access to off-road villages and farming areas. They can be available 24-hours a day, to assist with emergency medical journeys. Their main disadvantages are exposure to the elements, lack of comfort, low passenger and freight capacity, a higher risk of crashes than other vehicles and no protection in the event of a crash. Despite these serious concerns, the rapid expansion of motorcycle use in rural areas demonstrates that people value the convenience of the motorcycles, despite their safety record and disadvantages. Compliance with regulations requiring drivers and passengers to wear crash helmets is often low on LVRRs.

In many countries, motorcycle adoption led rapidly to motorcycle taxi services, some of which replaced bicycle taxi services. In some countries similar financing models developed spontaneously, with people such as shopkeepers or retired government officials buying motorcycles to rent out daily to young people who drove the motorcycles and gained income from passengers. Hiring out a $600 motorcycle for $2-3 dollars a day allowed it to be paid off in less than a year, and benefited the owner, the operator and the rural people who had convenient and readily available rural transport services. With such financial models, the market grew and was supplemented by small-scale loans from banks and credit organisations. The growth of motorcycle taxis coincided with the expansion of mobile phone networks, and mobile phones allowed motorcycle taxis to be called into villages, even off-road villages, to meet specific transport needs. Motorcycles can take few passengers and need to charge high tariffs per passenger-km. While high fares can be problematic for rural people, the availability and convenience of motorcycle taxis makes them popular with rural residents. Motorcycles and motorcycle taxis are now the main means of rural transport on numerous roads in many countries, although there are often many issues in terms of regulatory compliance and safety.

Figure 16 Motorcycles and motorcycle taxis

Countries (L-R): Liberia, Myanmar, Tanzania, Timor Leste

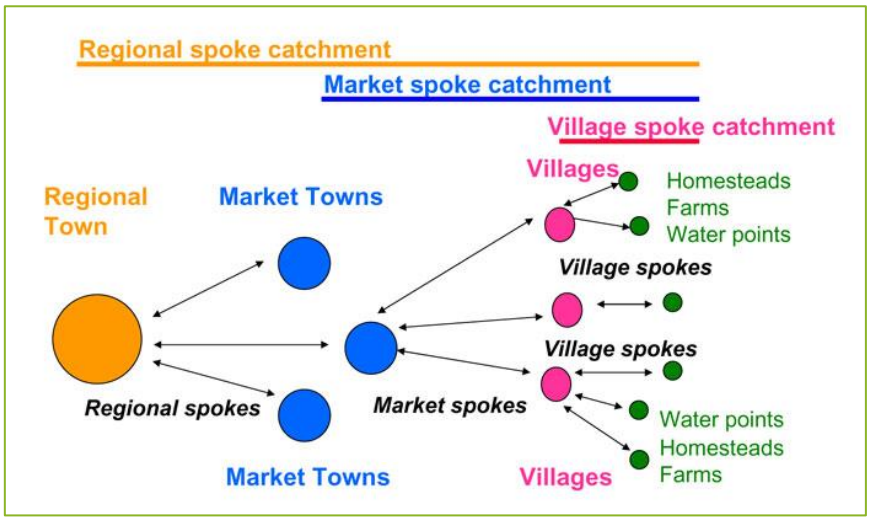
A wide range of other intermediate means of transport are used but tend to be more localised. Two-wheel tractors may pull freight trailers, and some are used for passenger transport. In some countries animal pulled carts provide transport services, although these are increasingly being replaced by three-wheelers or motorcycles.

5. Operational models

Most transport services operate on hub-and-spoke systems, with hierarchies of complementary hub systems. This is illustrated schematically in **Error! Reference source not found.**. There are national and regional hubs in cities, providing long-distance inter-urban passenger services with buses and perhaps express minibuses. Small market town hubs have low capacity transport services vehicles, that generally

carry mixed loads of passengers and freight between the market town hub and the surrounding villages. Depending on the transport demand and road condition, these may be rural taxis, pickups, minibuses and/or three-wheelers. Most transport services on LVRRs operate to and from market-town hubs, and they link rural passengers with the inter-urban bus services operating between market towns and provincial cities.

Figure 17 Conceptual model of a segment from a regional transport hub system



Inter-urban bus services are generally provided by formal private sector bus companies, parastatal bus companies or by some informal sector providers. However, transport services operating on LVRRs between market hubs and villages are almost always run by operators in the informal private sector. Low market demand and high operating costs restrict formal sector transport companies from such routes unless there are government subsidies or opportunities to travel beyond the market spoke to regional cities.

The operational model used by informal sector providers is quite similar throughout low- and middle-income countries. They tend to use old vehicles (low capital costs) and endeavour to travel with full (or over-full) loads on each trip. They may keep to one route and travel just one return trip a day, starting from a village in the morning and returning in the afternoon. They may work seven days a week. If demand is higher, they may make more than one trip a day, although if a second or third trip is required it may be provided by another operator that also shares the route. Where demand does not justify one trip a day, operators may serve several roads, particularly if there are busy rural markets away from the market town. On market days, they may make several return trips a day to villages with high market-day demand, but not return until the next market day.

Some rural transport operators have a simple timetable, leaving at the same hour each morning and returning about the same day each afternoon. Other than this, most operators wait for a full load before their departure. Their cash flows require them to make a profit on each trip, and they are reluctant to leave without a profitable load. This means that waiting times can be high, reducing transport demand which may cause operators to abandon low-demand routes. On some routes with high demand and passengers along the route requiring transport, a group of operators may start to operate to informal timetables, leaving when full, or if not full, every twenty minutes (or other frequency). This predictability tends to increase transport demand.

6. The regulation, enforcement and organisation of rural transport services

In most countries, the transport services regulating authority is quite separate from the roads' authorities, either under different ministries or under separate departments, with little interaction between them. They are generally small authorities or agencies responsible for vehicle and driver regulation with much administrative work relating to licensing (vehicles, drivers, routes) and testing (vehicles and drivers). They are generally urban based and concentrate on their income-generating activities and the regulation of urban transport services and inter-urban transport services. These services are the busiest, most visible and

the most politically sensitive transport services that demand their attention. Their staff tend to be based in the capital and in provincial cities, where there are both urban services and inter-urban bus hubs requiring their attention as well as the administrative issues such as licensing that takes up much staff time. With few (if any) staff at the devolved level of market-towns, the transport services regulatory authorities have little interaction with, or understanding of, rural transport services. There is little evidence from low and middle-income countries of transport services regulatory authorities undertaking proactive planning for rural transport services and following up such initiatives. It is mainly left to the local operators themselves and the devolved district authorities to organise services and the operation of the market town hubs. Enforcement on LVRRs is generally up to the local district authorities and the police.

Whatever the national regulations, when it comes to rural transport services enforcement is generally quite weak for three main reasons. Firstly, not all LVRRs are regularly policed: the police tend to monitor market town hubs and the roads leading into them. Secondly, the local police and district officials understand the operational practices of rural transport services and believe these are largely beneficial for the rural people who depend on them. The police are therefore tolerant of overloading and lack of regulatory compliance. In some situations, they ignore the low standards on LVRRs, but enforce higher standards passing inspection points on entry to the town, well aware that half the passengers had just disembarked from the normally overloaded vehicles. Thirdly, there are problems of corruption in many countries. The transport operators pay modest bribes to the police or other officials so that illegal practices can continue. In these circumstances, the police do not want there to be compliance, for this would reduce their incomes. The police and other enforcement officials have a vested interest in ongoing non-compliance.

The transport services regulating authorities can be contrasted with the authorities responsible for roads. In many countries, one road authority/agency deals with national and provincial roads, and another authority/agency deals with rural roads in collaboration with devolved, district level authorities. This means the rural road authority is almost invariably represented at the devolved levels of district or market-town hub. The engineers responsible for the maintenance of LVRRs are in regular sight of rural transport services, but they do not, yet, have any mandate to understand them better and assist with integrated approaches to infrastructure and transport services.

Operators of the same type of vehicle often form associations for mutual assistance and a certain degree of self-regulation, particularly in terms of organising market-hub terminals where operators generally queue, taking it turns to load passengers and leave. Operator associations can develop into anti-competitive cartels. Some develop into influential national organisations that can help implement regulatory changes or block them. Operator associations offer a possible mechanism for influencing developments in rural transport services, although the processes can be time-consuming and can falter due to issues of poor governance.

Annex 2 Alternative Road Investment Planning Models and Criteria

Ranking and cost effectiveness

Different ranking, and cost-effectiveness procedures have many formulations, however they are not deliberately designed to fit within a conventional economic framework. The procedures often include indicators or measures of social as well as economic demand, need or benefit. Compared with a conventional economic appraisal less attention is given to the precision of coverage of benefits. Sometimes the procedure will include a method of incorporating consultation in the selection and prioritisation of road investments.

An example of a cost-effectiveness criterion was proposed by Lebo and Schelling (2001) for very low volume roads. Here construction costs and population are the critical factors.

$$Cost\ Effectiveness\ Indicator\ of\ link(j) = \frac{Cost\ of\ Upgrading\ link(j)\ to\ basic\ access\ standard}{Population\ served\ by\ link(j)}$$

With this method improvement of links that have the lowest ratio are given the highest priority. In this example, it can be seen that road design solutions that achieve a basic access standard, at minimum cost for the greatest population (for example through a 'spot improvement' approach) will be selected.

Multi-Criteria Analysis

Multi-Criteria Analysis (MCA) is often used to combine economic, social, environmental and other considerations in the final choice of alternatives for both major and rural road investment. For each criteria the different projects are assessed and ranked (e.g. 1st, 2nd, 3rd, etc). This process is then repeated for the other criteria.

Weights are then assigned to each criteria and an overall score is obtained. The process is demonstrated below in Table A2 1. In this table, to achieve the desired result, the ranking is presented in reverse order, i.e. the highest number rank refers to the best.

Table A2-1: Example of Multi-Criteria Analysis

	Alternative 1			Alternative 2			Alternative 3		
	Rank	Weight *(%)*	Score	Rank	Weight *(%)*	Score	Rank	Weight *(%)*	Score
Economic evaluation	3	50	150	1	50	50	2	50	100
Environmental evaluation	2	30	60	3	30	90	3	30	90
Development	3	10	30	2	10	20	1	10	10
Public transport	3	5	15	2	5	10	2	5	10
Accessibility/ Severance	1	5	5	2	5	10	3	5	15
Overall score	-	-	260	-	-	180	-	-	225

The Road Economic Decision Model (RED)

The Road Economic Decision (RED) model was prepared for the Sub Saharan African Transport Program (SSATP) by the World Bank (World Bank, 2006a). RED is a spreadsheet-based model that is derived from the Highway Development and Management Model (HDM-4). RED is relatively simple to use and does not require specialist training. However, RED does require someone with engineering knowledge that is familiar with road roughness and typical interventions. RED is principally used for the evaluation of low volume unpaved roads and can be used for upgrading to a paved road standard. RED requires information on proposed investment costs, the associated road maintenance costs (with and without the investment),

traffic volumes, vehicle composition and growth rates, the road roughness level, measured in International Roughness Index (IRI), vehicle cost data, including the new vehicle price, and tyre and fuel prices.

The main advantage of RED is that it calculates vehicle operating costs from the input of vehicle component prices and road condition data (World Bank, 2006b). RED does not include road deterioration and works effects relationships (for example gravel loss equations) that are incorporated into HDM-4. Hence, unlike HDM-4, road condition is not forecast to change year-by-year. For the purpose of the model, maintenance costs must be averaged over the lifetime of the project and road roughness must be assumed to be constant during the appraisal period for each alternative considered. Using engineering judgement, the user needs to select the levels of roughness associated 'with' and 'without' the proposed intervention. Because vehicle speed is associated with roughness, speed may also be used in the model, to check or determine, the appropriate roughness levels.

Like HDM-4, the model has an economic framework and can calculate decision criteria such as the Internal Rate of return (IRR) and the Net Present Value (NPV). To increase flexibility and explore the cost consequences of different periodic maintenance treatments, many consultants use the vehicle operating costs (VOC) and time savings of RED and incorporate the results into their own models. A detailed review of RED and the data required to use it is presented in Rolt et al. (2020).

Transport fares and costs

Following any proposed interventions, the savings in transport costs may be calculated from the predicted changes in fares and tariffs for particular transport modes and on an estimate of the proportion of traffic that may be expected to switch between modes. This would be based on observed differences in fares and tariffs, for different vehicle types operating on roads with different characteristics. New traffic generated by an investment (i.e. 'generated traffic') may be estimated from historical data or predicted by the proportionate change in transport costs using an elasticity of demand. Transport prices elasticities are discussed in the IMPARTS Scoping Report (Starkey et al., 2019a).

Where data on fares and tariffs are inadequate to draw conclusions, the RED model may provide some guidance as to changes in VOC that might be expected following a road improvement. However, it should be recognised that, despite their apparent precision, there is considerable uncertainty over the validity of the VOC models, and that calculated savings, may not be passed on to passengers and customers. Table A2-2 provides an example of VOCs calculated by the RED model. Examples of fares and freight tariffs are given in Table A2-3 and Table A2-4. For example, it can be seen that motorcycle tariffs can be up to five times as expensive as bus tariffs.

Table A2-2 Example of vehicle operating costs, calculated by the RED model

Rolling Terrain	Car Medium	4-Wheel Drive	Minibus	Bus Heavy	Truck Medium	Motor-cycle
Costs: USD per vehicle-km						
Paved, Surface Dressed Road (Good Condition) Roughness: IRI 04	0.25	0.32	0.30	0.64	0.72	0.06
Gravel Road (Fair Condition), Roughness: IRI 10	0.32	0.46	0.37	0.89	0.99	0.07
Earth/Gravel Road (Poor Condition), Roughness: IRI 15	0.40	0.59	0.45	1.14	1.22	0.09

Source Rolt et al. (2020)

Where it is anticipated that pedestrians will switch to being passengers on motor vehicles then the transport cost savings will be based on the difference between expressed values of time less the fares they would pay. Surveys carried out in Ghana found that that the average rural value of time (for example for walking or cycling) was equivalent to 64% of the wage rate while in Tanzania it was 49% of the wage rate (IT Transport, 2005).

Table A2-3 Examples of average passenger fares per passenger-km on LVRRs in Nepal and Tanzania

Road	Section	Motorcycle taxi *USDc*	3-wheeler *USDc*	Jeep/Utility *USDc*	Minivan/Minibus *USDc*	Bus/Midibus *USDc*
Kavre (Nepal)	*Remote*	-	-	3.7		5.7
Kavre (Nepal)	*Busy*	-	11.6		7.6	5.7
Sindhuli (Nepal)	*Remote*	-	39.9	8.7	-	5.2
Bagamoyo	*Remote*	12.2	-	-	-	-
Hai	*Remote*	20.7	-	-	-	-
Babati	*Remote*	12.8	-	-	5.3	-
Bahi-Chipanga	*Remote*	12.1	-	-	-	-
Bahi-Chipanga	*Busy*	12.1	-	-	5.4	-
Bahi-Mpunguzi	*Remote*		-	-		2.9
Bahi-Mpunguzi	*Busy*	12.6		-		2.4
Morogoro	*Remote*	18.1	-	-	-	-
Note: most fares relate to the whole road including the remoter sections. Some transport types were only available on the busier sections towards the end of the road, and these are presented in separate rows						

Source: Starkey et al. (2020d)

For moving goods by headload, where people are specifically paid for the task, it has been estimated by Lebo and Schelling (2001) that it typically costs 10 to 12 times as much than moving goods by truck. However, charges are dependent on trip distance as well as the mode of transport involved. This can be seen in Table A2-4.

Table A2-4 Freight tariffs for different modes of transport in Tanzania, 2017

Vehicle	Crop	Survey	Distance	Charge
			km	*US cents/tonne-km*
Truck	Pineapples	Transporters	195	25
Saloon car	Pineapples	Transporters	108	75
Motorcycle	Pineapples	Transporters	31.5	291
Motorcycle	Pineapples	Farmers	1.25	1,787
Headloading	Pineapples	Farmers	0.36	20,391
Truck	Potatoes	Transporters	585	8.3
Animal cart	Potatoes	Transporters	2.5	388
Motorcycle	Potatoes	Transporters	1.7	557
Ox cart	Potatoes	Farmers	1.9	867
Donkey cart	Potatoes	Farmers	1.8	1,752
Motorcycle	Potatoes	Farmers	1.4	1,900
Headloading	Potatoes	Farmers	0.6	6,822

Source: Workman et al. (2018)

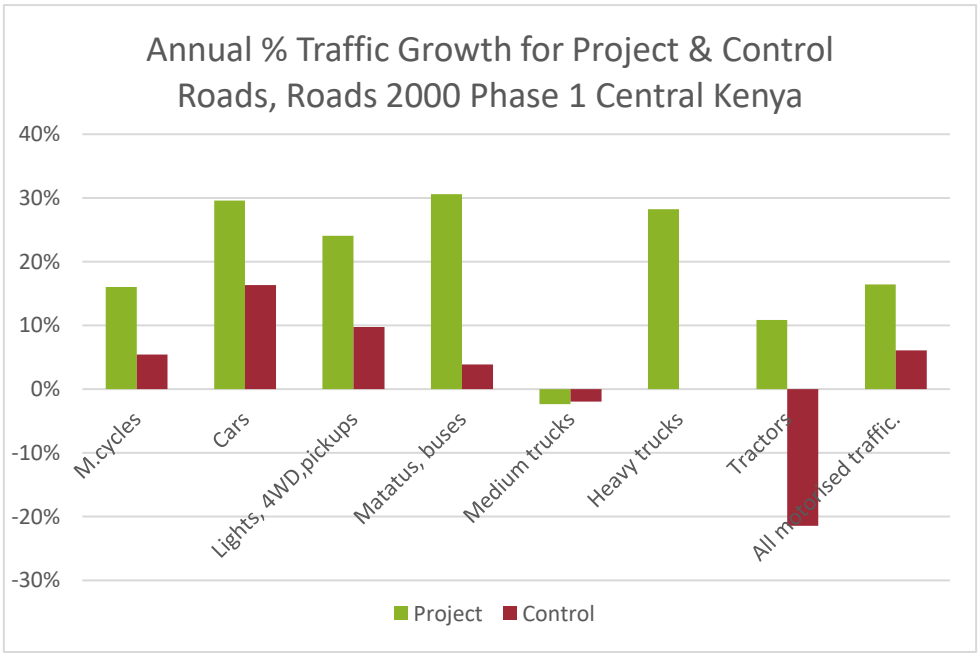
Factors affecting transport costs, fares and tariffs and modal composition

There are a range of factors that affect transport costs and modal composition:

- **Road characteristics.** Road roughness, measured as the International Roughness Index (IRI), and factors such as road gradient and curvature have long been used by the road planning models HDM-4 and RED as determinants of vehicle operating costs. Modal composition is affected by factors such as water crossings, surface water and deep mud. These will adversely affect vehicles with low clearance such as cars and minibuses. However four-wheel drive vehicles, tractors, motorcycles, and pedestrians may be able to pass. Steep gradients may prevent the use of bicycles or vehicles such as heavily loaded trucks with low power to weight ratios. Weak bridges will prevent heavy vehicles from passing. Narrow roads and tracks, for example with thick vegetation on either side, will also be a deterrent to wide vehicles such as large buses because of the difficulty in passing oncoming vehicles. There is also evidence from Kenya to suggest that improving rural roads and reducing road roughness (through bituminous surfaces or new gravel) may lead to reductions in passenger tariffs and encourage a relative increase in light vehicle traffic (including 'matatu' minibuses and midibuses) and a relative, but not necessarily an absolute, decline in motorcycle traffic (Hine and Bradbury, 2016). This is shown in Figures A2-1, A2-2 and A2-3.

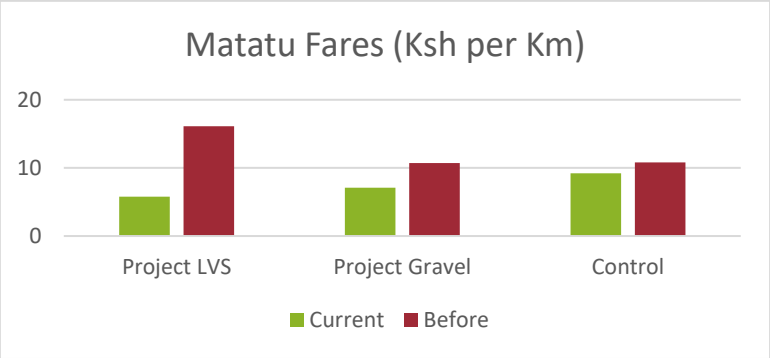
- **Traffic density.** Where there are small disbursed settlements, they may be insufficient demand to fill larger vehicles or make the service viable. If full loads cannot be achieved, then this will naturally increase fares and freight tariffs. In order to overcome the problem, buses may establish a specific timetable in order to group demand. However, where there is low density, a combination of walking and low capacity vehicles such as motorcycles and bicycles, may have to suffice, although transport costs will remain expensive.
- **Trip distance**. Trip distance has important effects on fares and tariffs and on modal composition. For any vehicle type, the shorter the trip, the higher the costs and fares when expressed on a per kilometre basis. Table A2-4 illustrates how freight tariffs decline with distance. Short distance trips in rural areas, for example under 2 km, are usually made by pedestrians or cyclists. Motorcycles typically undertake short to intermediate distance (say 2 to 15 km) trips. While longer intermediate trips, tend to be carried out by minibuses, and long-distance trips (say above 60 km) are made by larger buses. Trip distance will also affect freight transport in the same way. Usually it is only economical to use the largest trucks on long distance journeys while short distance freight trips are usually made by pickups and two axle trucks. Substantial transport cost savings may result if freight can be moved direct from field to market, avoiding intermediate, expensive, short distance collection costs (Workman et al., 2018).
- **Social and economic characteristics of the population**. Richer sections of the populations will tend to have access to private means of transport such as motorcycles and private cars. They will tend to use these in preference to public transport. Richer populations can also afford to use motorcycle taxis that may be unaffordable to many people. Access to resources within households are not evenly available to all. Women and children may have to walk, while men may use cycles and motorcycles. In some societies there are cultural constraints on women using bicycles and motorcycles.
- **Institutional organisation of transport services.** Governments often impose controls on fares. Services can also be sustained through subsidies. Operator associations can also control and influence fares through formal agreements and by controlling bus and lorry parks. An example is the Ghana Private Road Transport Union (GPRTU) organises transport terminals throughout Ghana and by controlling the vehicle queuing system, competition is supressed, and fares and tariffs are maintained at a high level. Operators associations were also discussed in Sections 5.2 and 5.6.

Figure A2-1. Kenya Roads 2000 Programme Phase 1. Annual traffic growth rates



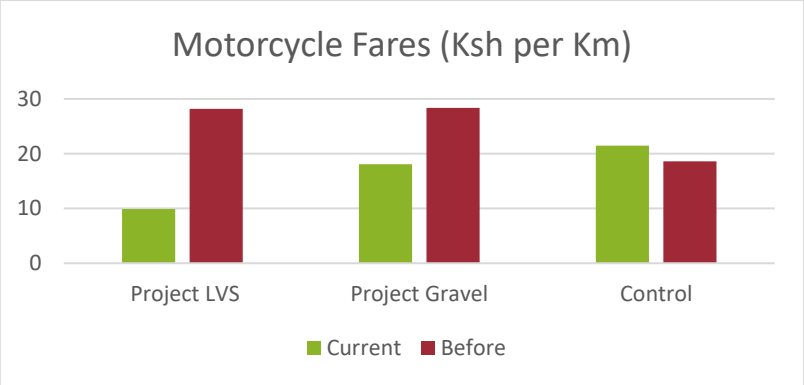
Source: Hine and Bradbury (2016)

Figure A2-2. Kenya Roads 2000 Programme: comparison of matatu fares, for LVS, gravel and control roads



July 2016 prices. Source: Hine and Bradbury (2016)

Figure A2-3. Kenya Roads 2000 Programme: comparison of motorcycle fares, for LVS, gravel and control roads,



July 2016 prices. Source: Hine and Bradbury (2016)

Planning the location and nature of road investment

Rural road investment should be located to have the maximum impact on transport costs, per dollar spent. In each case the estimated traffic volume that will use the road following the investment needs to be estimated. This is likely to be in the following situations:

- Where a substantial shift in transport mode is expected, i.e.
    - replacing a footpath by motorcycle track or conventional road,
    - where a road is seasonally impassable to conventional vehicles,
    - where the road width or road gradient prevents the use of larger vehicles
    - to cut out an intermediate transport link, for example, where agricultural produce needs to be first collected by small vehicles before transfer onto larger vehicles
- Where the existing road surface is very rough and traffic volumes are medium to high
- Where a substantial distance saving might result

Often a spot improvement approach (where a culvert is built, or a small road section should be improved) will give given the biggest impact for the money spent.

Care needs to be taken if large speculative investments are planned to connect locations where little traffic currently passes. In these situations, detailed investigations, for example interviewing likely users, should be carried out. Likewise, investments that only partially deal with a major constraint should be avoided. It is sometimes felt that a stage construction approach can be used. While this approach can be sensible if traffic is growing and is not hindered before the final construction is made, however it can also represent a waste of resources, both because of the time cost of money (the investment may be premature) and because traffic volumes may not materialise.