RURAL TRANSPORT RESEARCH IN SUPPORT OF SUSTAINABLE DEVELOPMENT GOALS

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ABSTRACT

Improved rural transport infrastructure and services are key enablers to increased rural resilience, rural empowerment and rural socio-economic transformation through poverty eradication, increased food security and hunger elimination, social integration, and improved supply chain logistics (UNCRD, 2017). This improved transport infrastructure and associated services needs to be soundly based on well-informed design, construction and maintenance principles and procedures.

It is the basic thesis of this paper that rural transport research plays an indispensable role in achieving more than half of the Sustainable Development Goals (SDGs). Research plays a key role in advancing rural transport by providing evidence to inform the key decisions on strengthening cost effective rural access and transport service processes to be promoted and embedded in practice in Africa and Asia. The research in this context has a particular focus on issues such as:

- *Cost effective design and maintenance processes for rural access;*
- *Climate resilience;*
- *Asset management;*
- *Safe and efficient transport services for people and goods (e.g. agricultural produce).*

This paper develops this concept of research as deliverer of evidence. It provides examples of the application and uptake of research. The paper also discusses the role of research in developing key markers and indicators to monitor, evaluate and guide this progress. This will be done by presenting the research background to initiatives such as Sustainable Mobility for All (SuM4All) and the Rural Access Index (RAI).

Keywords: Rural transport, rural research, research, Vientiane Declaration, sustainable mobility, SDGs

INTRODUCTION

Rural accessibility is primarily defined as the distance to all-season roads and transport services and includes the distance to market and basic services, as well as the critical initial link from agricultural production areas (the “first mile”). The provision of affordable, reliable, and inclusive rural transport infrastructure and services is at the heart of rural access.

Rural communities are expected to represent 34% of the global population by 2050 (UN DESA, 2014) and it is vital that they are not “left behind” in the 2030 Agenda for Sustainable Development. Based on the Rural Access Index (RAI) developed by the World Bank, about one billion rural dwellers live “without reliable transport” (World Bank, 2007). Most of the world’s poor live in rural areas isolated by distance, terrain and poverty from employment and economic opportunities, markets, and healthcare and education facilities (Starkey and Hine, 2014). Lack of reliable rural transport infrastructure (including paths, trails, bridges and roads) and lack of access to available and affordable transport services, create obstacles for rural inhabitants to attain economic freedom, healthy families, education and effective participation in community and national development.

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LINKAGES BETWEEN RURAL ACCESS AND THE SDGs

Rural access is a key enabler to achieving a number of the Sustainable Development Goals (SDGs) of the 2030 Agenda. Rural communities in developing countries are often completely disconnected from the major roads, rail lines, and public transport services that enable access to the economic and social activities and opportunities in cities (HLAGST, 2016). Rural transport is thus a main driver in solving the first-mile problem and enabling the rural poor to emerge from poverty and overcome social exclusion by connecting their goods to markets and linking rural areas to market towns, large cities, and the global marketplace (TRL Ltd, 2017).

Although there is no dedicated SDG target on rural access, there are numerous linkages between rural access and the SDGs. Successful scaled-up implementation of rural transport will contribute to realizing SDG 1 to alleviate poverty; SDG 2 to achieve zero hunger and ensure food security; SDG 3 to ensure health and well-being; SDG 4 to provide access to education; SDG 5 to empower women in rural areas; SDG 6 to facilitate access to clean water and sanitation; SDG 8 to promote inclusive growth and economic opportunities; SDG 9 and SDG 11 to contribute to sustainable infrastructure and communities for all; and SDG 13 to increase climate resilience and adaptation in rural areas. In addition to indirect linkages to SDGs and associated targets, there is a direct linkage to rural access in SDG indicator 9.1.1 ("Proportion of the rural population who live within 2 km of an all-season road"), developed by the Interagency Expert Group on Sustainable Development Goals (IAEG-SDGs).

VIENTIANE DECLARATION ON SUSTAINABLE RURAL TRANSPORT

The role of rural transport in achieving the SDGs is reflected in the Vientiane Declaration on Sustainable Rural Transport towards Achieving the 2030 Agenda for Sustainable Development, which was recently adopted by representatives of 23 member countries and 14 observer countries of the 10th Regional Environmentally Sustainable Transport (EST) Forum in Asia, convened by the United Nations Centre for Regional Development (UNCRD 2017). The Declaration demonstrates the collective commitment of government authorities, development agencies, civil society and other relevant stakeholders in the EST region to promote inclusive, affordable, accessible and sustainable rural transport infrastructure and services, in order to facilitate improved access to basic utilities and services of the rural poor and vulnerable groups.

The Declaration recognizes that essential steps to achieve the SDGs in the rural sector include "developing and maintaining rural transport infrastructure (e.g. footpaths, tracks, trails, farm and feeder roads, railroads, waterways, bridges and drainage systems); expanding rural transport service networks to promote education and health in isolated areas; and improving rural transport access to provide enabling environments for trade and commerce". The Declaration also acknowledges that improved rural transport infrastructure and services are key enablers to increased rural resilience, rural empowerment and rural socio-economic transformation through poverty eradication, hunger elimination, social integration, increased food security and improved supply chain logistics. In addition, climate adaptive and disaster resilient transport investments in rural areas can help secure all-season access to markets and essential services and prevent isolation of fragile or remote communities, thus contributing to economic development and well-being.

The Vientiane Declaration represents a milestone for both the EST regional process and the international community in recognizing the role of rural transport in achieving sustainable development and in identifying concrete actions for the public and private sector, international organizations, bilateral and multi-lateral agencies, non-governmental organizations, and scientific and academic communities to promote sustainable rural transport infrastructure and services.

KEY MESSAGES ON RURAL TRANSPORT

Over the last few decades, the UK Department for International Development (DFID) and others have committed significant resources into researching relevant themes and optimum solutions to increase rural access in developing countries.

To underscore the critical role of rural transport in achieving the SDGs, a set of key messages has been developed by ReCAP, supported by the Partnership on Sustainable, Low Carbon Transport (SLoCaT, 2017):

1. Improved rural transport drives sustainable rural development and national growth: Good rural road infrastructure and services promote connectivity and social cohesion, drive commercial activities as well as accessibility to social and economic facilities necessary to counteract poverty, isolation and social exclusion.
2. Better rural transport is key for food security and zero hunger: Improving rural access can lead to lower costs for farm inputs and lower transport costs for marketed outputs, thus increasing agricultural production to enhance food security.
3. Poor rural transport condemns the poor to stay disconnected and poor: Access to markets and employment opportunities through better rural transport infrastructure and services is an essential pre-condition to generating rural income and thus reducing poverty.
4. Additional money and commitment is needed to build and maintain rural road networks and develop sustainable rural transport services: Existing funding sources need to be expanded and new funding sources need to be developed, piloted and implemented noonly for building but also for managing and maintaining the asset.
5. Better rural transport calls for local solutions for local challenges: Rural access challenges require local resource-based solutions that are compatible with the local road environment conditions.

These key messages will drive short-term advocacy for the need to allocate more financial and human resources to improving rural transport infrastructure and services, and can also form the basis of a long-term research agenda to build further evidence on ways to increase rural access and to create lasting institutional change through uptake and embedment of this evidence.

RESEARCH INTO SUSTAINABLE RURAL ACCESS

The role of research into rural access

The importance of research on rural access is recognized in the Vientiane Declaration alluded to in Chapter 1. The Declaration speaks directly to the link between research and improved rural access by stipulating signatories to "utilize the outputs of research for innovative methodologies to provide more sustainable and appropriately-engineered rural connectivity." The key role of research in support of the SDGs and associated declarations can be summarized as providing high quality relevant data and evidence to inform the rural transport policies and practice and to deliver the innovations that are essential to the technical solutions to overcome the rural access challenges. At the same time, the international development agenda can provide direction for the long-term research agenda on rural access.

Typical rural access issues related to the SDGs that are being addressed in Africa and Asia by current research include:

- Rural access as an important driver of poverty alleviation;
- Sustainable rural access designs that are "fit-for-purpose" and in line with locally available resources and the physical and climatic environments;
- The cost-benefits accruing from improved all-season rural access;
- The relationships between "first mile" road condition on the quality and quantity of agricultural produce and hence its contribution to reducing food waste;
- Gender mainstreaming and equality in rural transport;
- Rural transport inclusiveness for women and girls, people with disabilities and the elderly;
- Improving the safety or rural access roads through eradication of accident "black-spots";

- Innovations in the delivery of transportation services through the safe use of motorcycle taxis and three-wheelers.

Uptake, embedment and effective knowledge management

Rural transport research is only effective to the extent that the evidence created through it is widely disseminated, taken up and embedded in national policies, institutions and research practices. It is also clear that undertaking research and developing likely solutions are not nearly enough. While previous rural transport research has delivered well in terms of output and adequately in terms of dissemination, it has performed less well in terms of uptake and embedment (Greening et al, 2010). Resistance to the use of new research has in the past been a major challenge to the transfer and application of new knowledge in the transport sector. Although this may be partly due to the inherently conservative nature of the civil engineering profession, the main reason has been the lack of sustained focus on the part of research programmes to look beyond dissemination and take on board a responsibility for uptake and embedment into policy and standards. This situation has not been helped by the frequently lengthy path from research to full embedment, which typically requires a much longer length of time than the timescale of most donor-funded research initiatives. The cost benefits of high quality applied rural transport research are now, with the advantage of longer time scales, becoming more obvious (Hine et al, 2017). Drawing on lessons learnt from previous programmes, the structures put in place in the framework of the ReCAP programme address these challenges in a number of ways:

- The research programme and its continuing development is compatible with an identified business case and strategy.
- Individual projects are demand driven by partner countries, or groups of partner countries, through national and regional steering committees.
- The research programme has, or is developing, an institutional home in each partner country with the necessary resources, knowledge and experience to carry forward the outcomes.
- There is clear focus, through an appropriate Road Research Centre (RRC), university or government department for the review, adoption, acceptance and embedment of research findings into standards, specifications from national through to local level.

These arrangements ensure local ownership and stewardship of the research that is implemented. Alongside national research projects, formulated based on national needs:

- Strengthening research influence on policy: translating and synthesizing research evidence into policy implications and impacts and facilitating policy dialogues with key policy makers and other stakeholders.
- Strengthening research uptake by practitioners: supporting the documentation, storing, accessing, publication and dissemination of research.
- Strengthening countries' rural road and transport research capacity through better knowledge management.
- Strengthening the interconnectedness of rural access practitioners' communities internationally.

The knowledge management activities are guided by four strategic directions that include:

1) Enhancing research uptake; 2) Improving access to and dissemination of rural road and transport services evidence; 3) Supporting Rural Access networks and communities of practice; and 4) Increasing the influence of rural transport in high-level development debates.

The development of the concept of the Inter-Regional Implementation Meetings (IRIMs) was based on the success of previous smaller meeting such as:

1. A ReCAP Knowledge Management and Dissemination workshop in Caledon, South Africa, November 2016, addressing the themes of road asset management and the institutional capacity for knowledge management of transport research institutes in Africa and Asia.
2. A ReCAP Workshop in Dar Es Salaam, Tanzania, April 2017, addressing the themes of climate resilience and adaptation for rural road networks and back analysis.

The first full IRIM was held in Uganda in November 2017, and was structured around the key pillars of the ReCAP programme; the provision, preservation and use of rural road networks as drivers of sustainable rural mobility.

Additional research, recently initiated (ReCAP, 2017), is aimed at exploring by research the historical links, or gaps, between the assumptions made in rural infrastructure design and the end-product delivery of rural transport of freight and passengers. The outcomes are expected to be a major contribution to an understanding of the modalities within the continuum of provision, preservation and use of rural access.

EXAMPLES OF RESEARCH EVIDENCE

Research evidence groups

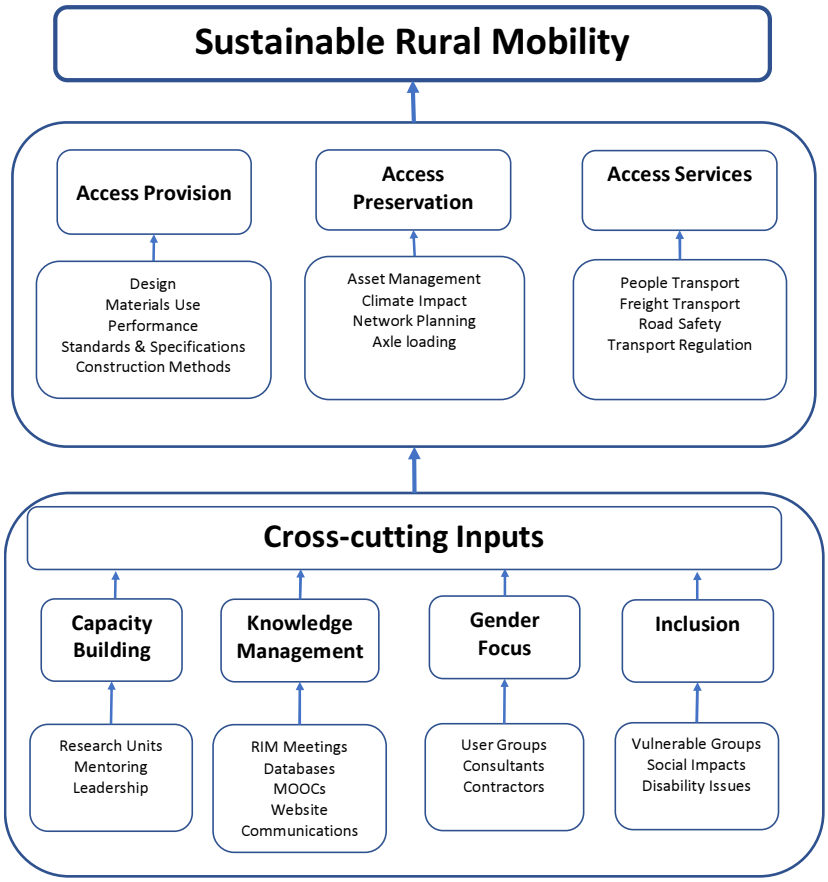
The strategy as refined for the years 2017-2020 focuses on the delivery of research supporting sustainable rural mobility. This drive towards sustainable rural mobility in terms of WF17-20 will be through the three principal research targets:

- Provision of rural access
- Preservation of rural access
- Effective use of rural access (or Transport Services)

Cutting across and supporting these three targets are four key support themes:

- Capacity Development
- Knowledge Management
- Gender
- Inclusion

Figure 1. Key Elements of Rural Access and Sustainable Mobility



Provision of rural access

Many aspects of the design and construction of roads in developing countries have stemmed from technologies and practices emanating from Europe and the United States some 40 years ago. These practices have, to some extent, been modified in the intervening years, but the basic philosophy of road provision has remained the same. While these "standard" approaches might still be appropriate for the main trunk and link road network, they are overly conservative, inappropriate and far too costly for application on much of the rural road networks. In facing the challenges of improving and expanding a country's low volume road network, application of the traditional planning, design, construction and maintenance practices cannot provide a suitable and sustainable solution.

Many innovative practices and unconventional techniques have emerged to benefit fully from these advances and to see necessary improvements implemented on the ground. Compilation of these documents has been, and is being undertaken in close consultation with the local stakeholder community to learn from local "best-practice" (Cook et al, 2013) and to enhance the uptake and embedment by the stakeholders.

Key issues that have been researched and whose outputs are now being applied include:

- Guidance on the appropriate use of sealed as opposed to unsealed surfaces.
- Design and construction of bituminous seals.
- Innovative use of the Dynamic Cone Penetrometer (DCP) as a pavement design tool.
- The performance and guidance to selection of a range of unsealed, bituminous, concrete and block pavement surfaces.
- Appropriate use of local natural construction materials.
- Appropriate standards and technical specification of LVRs.

The typical outcomes from the development of the LVR manuals were illustrated by Sampson et al (2014). An independent review of the uptake of the Ethiopia LVR manual in 2013 concluded:

1. The LVR Manual has been widely distributed and used in Ethiopia, mainly for the Universal Rural Road Access Programme (URRAP). A total of 1,300 hard copies have been distributed by the Ethiopian Roads Authority (ERA) in addition to soft copies downloaded from their website. Overall, it was estimated that approximately 7,000 individuals in nearly 2,000 organisations are using the Manual.
2. The roads upgraded by URRAP using the LVR Manual are achieving all weather access in many areas that were previously inaccessible to motor vehicles.
3. The LVR Manual has contributed to capacity building and knowledge transfer on low volume road design through:
4. Involvement of local stakeholders in the preparation of the Manual;
5. Their use in the training of individuals involved with designing and implementing the URRAP; and
6. Training of trainers for URRAP. It is estimated that over 3,600 professionals have been given training on labour-based technology and low volume road design using the LVR Manual

Whilst the majority of the current new manuals have been aimed at Sub-Saharan countries, the clear principle is that these documents can be easily adapted and transferrable to be taken up and adopted for use in Asian countries (Cook et al, 2015).

Preservation of rural access

Rural road asset management in developing countries Sub-Sahara Africa and Asia tends to be characterised by a poor maintenance culture, lack of human resources, inadequate funding, reliance on inappropriate technologies, poor quality control, mismanagement and corruption. Based on the outcomes of the formulation phase of the AfCAP project for "Economic Growth through Effective Road Asset Management" (Roughton et al, 2016), there were very few examples of sustainable rural road asset management currently operational in Sub-Sahara Africa. Where examples of good practice exist they tend to be on donor-funded programmes with high levels of technical assistance, but these initiatives tend to flounder when the donor support is withdrawn. Following from this, ReCAP are currently funding a highly innovative approach aimed at achieving meaningful results by building a maintenance culture in the three participating countries (Civil Design Solutions 2016-17). This will be achieved through an evidence-based approach to changing the mindset of policy makers and targeted technical assistance at the implementation level. The performance of the participating roads agencies will be measured against a new framework for evaluating road agency performance in rural road asset management that is being developed as part of the study. The output of this evaluation will be used as a basis for discussing with participating countries what can or should change to improve the ability of the roads agency to perform in a more effective and efficient manner. The findings of the evaluations will be discussed with road sector stakeholders in the project areas and in regional meetings of the participating countries as part of an influencing strategy to improve performance in road asset management and, ultimately, to achieve home-grown and sustainable improvements to the management of rural roads. As part of the project, a Road Asset Preservation Index (RAPI) is being developed. The RAPI is a composite measure of the performance across the six asset management building blocks. The RAPI is a new concept that will be further developed as the project progresses.

Additional research initiatives underway in support of access preservation are:

1. A review of the suitability of high technology solutions, primarily based on satellite imagery, to provide reliable inventory and condition data for rural infrastructure to assist in the management of rural assets (TRL Ltd, 2016-17). This is particularly relevant for remote rural areas and conflict areas where access is difficult.
2. Development of guidance on the assessment of current and future climate impacts on LVRR networks; how to assess this and identify and prioritise appropriate resilience measures (CSIR et al 2016-17).

3. Research into the use of intermediate equipment, such as the agricultural tractors, in the provision of LVRR maintenance in both Africa and Asia (Petts 2012). This offers a solution to the current challenges faced due to the dependence on the use of imported heavy and expensive equipment. In developing countries, agricultural tractors are desirable to increase productivity and reduce the farm work burden, particularly for the poor. Bringing agricultural tractor and towed grader technology to the rural road sector will increase overall annual equipment utilization, reduce unit costs to more affordable levels and accelerate 'payback' of the capital investment for owners.

TRANSPORT SERVICES OR USING RURAL ACCESS

Planning, building and preserving rural access networks are not an end in themselves; there has to be an effective use to establish the vital support to delivery of the SDGs. There must be strong links between the roads we build and the transport that uses them. While there is strong evidence of the effectiveness of rural access in development terms there is far less information on whether this rural access could be delivered in a better manner. In other words little has been done to back analyse how effective road projects have been in delivering sustainable 'fit for purpose' access at the most effective whole-life costs and usefulness. Very little attempt has been made to review design assumptions on the key impact factors so that future projects can adapt to lessons learnt.

There is a general impression that rural transport services have been substantially neglected by government decision makers and aid agencies. There has been concentration on roads but it has been predominantly left up the rural population and the market to deal with providing transport. There is little guidance, resources, legal framework, monitoring indicators or management provided to deal with transport services. However, within the rural access continuum, from provision to use, has identified a opportunity for a research initiative for holistic research both into the changes occurring in rural transport services following the rehabilitation or upgrade of LVRRs and the appropriateness of the assumptions made in providing and preserving the access. This is with a view to providing informing a more cohesive approach to the provision of sustainable rural mobility for people and transport. The research will also be used to inform relevant cost benefit assessments of recent LVRR rehabilitation or upgrade. It is anticipated that the research will assess changes in:

- Types of vehicle using the consequences (axle loading);
- Rural freight patterns and costs;
- Passenger traffic patterns and costs;
- Vehicle operating costs.

Transport constraints on rural livelihoods are not simply a result of poor road condition, but are a culmination of inadequate infrastructure, lack of appropriate and affordable means of transport, remoteness and physical isolation from basic services. Recent and current transport services projects have addressed this issue by significant research into the effective use of motorcycle and three-wheelers for the transport of people and freight in remote locations; this addressing central issues in the support of SDGs (Starkey, 2016).

MONITORING AND EVALUATING RURAL ACCESS AND ITS CONTRIBUTION TO THE SDGs

Research and the Globalisation of Mobility for All

The Sustainable Mobility for All (SuM4All) Initiative is essentially a global tracking framework to monitor and assess progress in transport towards achieving the SDGs. SuM4All intends to act as platform for advocacy to influence policies on sustainable mobility at global to local levels; to provide an platform for action in generate transformative concepts of mobility to be adopted across a range of country contexts; and to serve as a platform to mobilize financing to support the widespread implementation of these policies and investments. SuM4All aims to facilitate the delivery of four primary objectives of sustainable transport, which include Universal Access, Efficiency, Safety, and Green Mobility. Rural Access and Urban Access are the two sub-objectives under the SuM4All

Universal Access objective. The DFID has been active in drafting the Rural Access elements for the initial draft GMR 2017.

A narrative has been developed within a Global Mobility Report (GMR 2017) to outline definitions of rural access and its linkage to global agendas; trends and future projections for rural access; methodological challenges in measuring rural access; and an assessment of the scale of these challenges. A number of case studies on rural access are presented to support the narrative on the importance of rural access in achieving the SDGs, which cover a range of topics in rural transport, including women's empowerment through rural road maintenance; impacts of asset management on road users' transport costs; impacts of public rural road investments on poverty alleviation and agricultural growth; importance of intermediate means of transport and the "first-mile challenge;" and impacts of the lack of access to rural transport services on poor, disadvantaged, and vulnerable groups. In addition, a set of principal indicators and associated supporting indicators is being developed under the GMR global tracking framework.

The GMR 2017 establishes a baseline for data and indicators, and periodic updates are planned to refine indicators and update trend analyses. The planned application of the GMR includes engaging national and subnational governments in dialogue on sustainable mobility supported by a country dashboard, which can help to identify "high-impact" countries that can be targeted for further action to achieve global goals on sustainable development and climate change.

Taking into account the issues outlined in the previous sections, the ReCAP programme to 2020 and beyond is seen as being within a research framework that is re-focused on a Sustainable Rural Mobility theme (rather than broad rural infrastructure and transport services themes) that works alongside parallel initiatives such as SUM4All aimed at supporting and monitoring the achievement of key Sustainable Development Goals. ReCAP thus becomes an informing key link between high level strategic thinking and the practical issues of fit-for-purpose access in a wide range of socio-economic and physical rural transport environments.

Inclusivity is at the heart of this SuM4All global objective. It aims to ensure that everyone is provided with at least some basic level of access through sustainable transport services, and "no one is left behind" within a diversified transport infrastructure that provides opportunities for employment, education, and equality, reduces conflicts, and promotes health, leisure and participatory planning.

Developing a new Rural Access Index

The Rural Access Index (RAI) is a headline indicator established by the World Bank in 2005 to focus on the role of access and mobility in the reduction of poverty in developing countries. The RAI, developed by Roberts et al (2006), measures the proportion of people who have access to an all-season road within an approximate 2-km walking distance. This has been widely adopted as a global development indicator for transport accessibility and is an indicator for SDG9 (resilient infrastructure). It had, however, come under increasing criticism in terms of weak operational relevance, client ownership and being costly to update. A review of the RAI and proposed a new way of tracking it, based on spatial data and techniques whilst using the original definition. For clarity in this document the "Updated" RAI is referred to as the Spatial Rural Access Index (SRAI) in order to distinguish it from the original RAI.

SRAI Phase I Identified four key weakness in the original RAI:

1. Inconsistency across countries;
2. Lack of sustainability in terms of regular update;
3. Weak operational relevance;
4. Weak client ownership.

The SRAI was then developed with the aim of establishing a sustainable, consistent and operationally relevant method to measure rural access, using newly available data and spatial data collecting technologies. The work was piloted in Ethiopia, Kenya, Uganda, Tanzania, Mozambique, Zambia, Nepal and Bangladesh.

Based on the outcomes of the research into SRAI Phase 1 the Word Bank has proposed a Phase 2 of the SRAI. The fundamental aim is to move the SRAI forward to a modified solid base

using recently cost-effective high-tech tools research and working within a sustainability framework. A number of clear Task Groups may be identified:

- Task Group 1: Status Review and Consolidation;
- Task Group 2: Application in Pilot Countries;
- Task Group 3: Roll out to Additional Countries.

Rural transport research will play a vital and increasing role in the successful delivery of the update to this important sustainable mobility index.

CONCLUSION

Rural transport research has made and will continue to make a positive contribution to sustainable mobility and support to relevant SDGs. The importance of this research is increasingly being acknowledged, as evidenced Vientiane declaration, and opening up very positive opportunities for previously marginalized rural communities.

The high quality research in the transport sector, primarily in Africa and Asia, as focused evidence to inform high level policy as well pragmatic local level decisions on the provision, preservation and use of rural access through an increasing emphasis on the uptake and embedment of the research outputs.

One key lesson learnt from the previous decades of research is the long time frames required to fully achieve embedment of research into cost-effective policy. From this it is evident that support to rural access research needs to be continued and sustained over the long term in order to fully support the achievement of SDGs.

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