

Monograph Series on Sustainable and Inclusive Transport

Enhancing rural transport connectivity to regional and international transport networks in Asia and the Pacific



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Executive Summary

Rural areas across much of Asia are undergoing profound economic, social and demographic changes. Not only goods and people, but ideas, values, and cultural practices are moving both physically and virtually, across multi-layered transport networks. “Vertical connectivity”, or connectivity between micro-, meso-, and macro-level networks, is becoming increasingly more important for the development of agricultural value chains; access to jobs in urban areas; the reduction of food loss and waste; rural tourism; health supply systems; disaster preparedness; and other dimensions of rural development. Policymakers therefore need to take a more comprehensive approach to rural transport planning to ensure that these different network levels are connected.

Transport systems can be said to be made up of infrastructure, transport services, and transport nodes. Most rural transport sector plans focus on rural infrastructure development, particularly rural roads. Countries such as Bangladesh, China, and India, have made tremendous progress in connecting rural areas through large-scale rural road construction programmes. More recently, governments are trying to increase the benefits of these roads by integrating connectivity from local to higher level networks into investment decision-making processes. Some governments, including China and Sri Lanka, are also proactively supporting rural services such as passenger buses. New ride-hailing motorcycle services, such as those popular in Indonesia, may have the potential to improve service connectivity in rural areas in the future.

Transport nodes link infrastructure and services within and between network levels. From the perspective of rural connectivity, three types of nodes deserve further attention. First, rural freight centres play an important role in e-commerce, which is becoming increasingly important for both consumers and producers as ICT connectivity extends into rural areas. Secondly, roadside markets help rural residents to access macro-level transport networks. Thirdly, “macro-nodes” such as air and seaports, dry ports, border crossings, and bus and railway stations, can have significant impacts on local economies. Increasing local people’s access to various types of nodes, for example by improving rural roads and services, could enhance their welfare, but further research is needed on the impacts of transport projects and policies as it has been found that different groups react to such interventions in different ways.

To design effective rural transport policies, governments need a large volume of data as well as the technical capacity to analyse this data. Most governments have road asset management systems, but not all rural roads are included. In order to monitor target 9.1 under SDG 9, the international community adopted the Rural Access Index (RAI), which is the share of the rural population who live within 2 kilometers of an all-season road as a proportion of the total rural population. While there are still challenges in using the RAI as a universal indicator, research is currently being conducted to try to overcome these challenges. Already, Geographic Information Systems (GIS), data collected from mobile phone movements, unmanned aerial vehicles, and other technologies are helping to capture relevant data. As these technologies evolve, it will become easier for countries to monitor transport connectivity.

Rural transport connectivity is clearly an important transport sector goal for governments in Asia and the Pacific. More investment in rural transport infrastructure can help improve connectivity, but it needs to be targeted to link different network levels together. Rural road asset management systems should be strengthened. Meanwhile, investments in rural transport services and nodes are also needed to improve the efficiency of rural transport systems. Governments need to increase their efforts in collecting and analyzing relevant data to monitor progress, including the Rural Access Index. Furthermore, more cooperation is needed between all levels of government entities, as well as between stakeholders from different sectors, to share information and experiences. More policy-relevant research should be commissioned on how rural transport can contribute more effectively to greater mobility and higher living standards in rural areas.

Definitions and Concepts

Rural transport connectivity: There is no universal definition of connectivity. ESCAP defines “connectivity” as “the capacity for areas and people to be connected, either physically or non-physically, through transport or communication” (UNCRD, 2017a). Some researchers measure the connectivity of a place by the number of trips taking place to/from that place, while others measure connectivity by access to rural roads, such as in the case of the World Bank’s Rural Access Index (RAI). In this monograph, the term “rural transport connectivity” is used in a broad sense to refer to rural transport infrastructure, services, and nodes (see Box 3 for additional ways the concept of connectivity is understood).

Rural transport infrastructure: Rural transport infrastructure includes the rural road network, which generally refers to tertiary road network (i.e. all roads which do not fall under the secondary or primary road networks – see below); paths, tracks and trails; and local bridges. For many Asian countries, inland water transport (IWT) is an important rural transport mode: infrastructure supporting IWT include jetties and landing facilities. Meanwhile island and archipelagic countries, such as Indonesia, the Philippines, Maldives and countries in the Pacific, require ports and associated infrastructure to support inter-island shipping services.

Rural roads: There is no universal definition of rural roads. Rural roads are commonly planned, constructed and managed by the rural local governments in the areas under their jurisdiction. Forest roads, canal roads, and village roads can also come under this category. Some studies define “low-volume rural roads” (LVRR) as being roads carrying an Average Annual Daily Traffic (AADT) of 1000 vehicles per day or less, including both paved and unpaved roads (Faiz, Faiz, Wang and Bennet, 2012). Banjo et al. (2012) define rural roads as those connecting settlements “of less than 2000 to 5000 inhabitants to each other or to higher classes of roads, market towns and urban centres”, while non-rural roads are those which connect settlements “of more than 5000 inhabitants to each other or to higher classes of road, market towns and urban centres”. However, such population-based classification systems are less useful in the Asian context because rural population sizes vary widely from country to country. For the purpose of this document, rural roads refer to all roads in rural areas which do not fall within national and provincial/state networks.

Rural transport services: Rural transport services include commercial passenger transport services, commercial freight transport services, and public passenger transport services. They operate within rural areas and between rural and urban. Although strictly speaking they are not services, the term also covers privately owned vehicles and intermediate means of transport (IMT). IMT include wheelbarrows, handcarts, trolleys, bicycles, tricycles, motorcycles and power tiller trailers, many of which may be used in combination with human and/or animal power (Starkey & Kaumbotho, 2000).

Transport nodes: Transport nodes connect places, people and functions. They can be central places where significant functions, such as secondary schools, health centres, and administrative centres) or where interactions to meet production, service and consumption needs take place (such as markets). Nodes are places where transfers of passengers or goods take place, and can include transport junctions, transshipment points, and Road-Railway heads. For freight transport, they include logistics platforms, dry ports, logistics zones, centres for commodity exchanges, and inter-modal centres. In rural areas, less formalized spaces where exchanges take place, such as local markets, are also important nodes.

Subregional, regional and international transport networks: In this document, regional networks include the Asian Highway, Trans-Asian Railway and Dry Ports of International Importance; subregional networks such as those defined by the Association of South East Asian Nations (ASEAN), South Asian Association for Regional Cooperation (SAARC), Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), and so on; corridors such as the ADB’s Greater Mekong Subregion (GMS) corridors, South Asia Subregional Economic Corridors (SASEC) and Central Asia Regional Economic Corridors (CAREC); and airports and maritime ports.



Assam, India, 2010. Source: Michael Foley

1 Introduction

Rural transport is a lifeline for roughly 50% of the world's population. Rural transport facilitates people's access to jobs and markets; schools and health clinics; social events and religious gatherings. It supports the movement of essential goods into rural areas, such as inputs to agricultural production, as well as the movement of goods out of rural areas, such as food and forestry products heading for urban markets. Without rural transport, the people who provide services to rural residents, such as government officials, agricultural extension workers, teachers, and health workers, would not be able to reach them; nor would rural residents be able to access such services in nearby towns. The Sustainable Development Goals (SDGs) 9 and 11 include targets related to the development of rural transport, but these are not ends in themselves. Rural transport systems are important because they enable the achievement of many other Sustainable Development Goals (Box 1).

Studies evaluating the relationship between rural infrastructure investment and socio-economic indicators have generally found that there is a positive relationship between access to rural roads and economic and social welfare.¹ However, not all rural road projects deliver economic growth, nor reduce poverty significantly (Setboonsarng, 2005). Reasons for this include *technical shortcomings*, such as the engineering skills of local government and construction companies; *budgetary shortcomings*, which affect the quality of roads or effectiveness of maintenance; *problems of governance*, such as poor enforcement of axle-load regulations; and *negative externalities* of rural roads, such as worsening traffic safety or air pollution.

¹ There are several comprehensive reviews of the literature on the relationship between transport and poverty, such as Brennen and Kerf (2002), Starkey and Hine (2014), and Jennings (2016). Porter (2014) and Banjo et al. (2012) review studies specifically on rural transport, but mainly in the African context.

While all these factors are important, another reason may simply be that building rural roads is insufficient to stimulate economic growth or reduce poverty. This shouldn't come as a surprise. Having a motorable road may open new opportunities for local residents, but their ability to take advantage of such opportunities depends on factors such as the social, economic and geographical context; household and individual circumstances; availability of transport services; and what facilities the road connects to. For example, if an area has potential as an agricultural production area, or has abundant raw materials for industry, then the chances are higher that the road improvement project will stimulate economic production or attract new investment. If population density is high enough, and enough residents are willing to pay, the project may attract more transport service providers. If a rural area is close to a town or city, then an improved road may make it cost effective for people to commute to manufacturing or service jobs.

All these conditions suggest that rural roads should not be viewed in isolation, but as part of a broader transport network, which in turn supports a wider economic and social system. Physical infrastructure connectivity is important, but so too are transport services and the nodes which link transport networks to each other. Yet many governments in the ESCAP region still plan their rural transport network independently of the rest of the transport system and leave rural transport services to the private sector to manage. They do not always realize that they could be playing a bigger role in fostering connectivity between transport networks.

1.1 Linking rural transport to the wider context

Improving rural connectivity is a concern not only of local level government, but also those agencies responsible for national, state and other transport network levels. In view of ESCAP's historical involvement in regional transport agreements, namely the intergovernmental agreements on the Asian Highway, Trans-Asian Railways and Dry Ports of International Importance, the Ministerial Conference on Transport at its third session in 2016 mandated the ESCAP secretariat to develop a policy framework to improve rural transport connectivity to these regional networks (see Programme Area 6, Regional Action Programme for Sustainable Transport Connectivity in Asia and the Pacific, 2012-2021).² Furthermore, in the "Vientiane Declaration on Sustainable Rural Transport towards Achieving the 2030 Agenda for Sustainable Development", countries participating in the 10th Regional Environmentally Sustainable Transport (EST) Forum in Asia committed to "initiate the development of national strategies and policy frameworks to improve rural transport connectivity to wider local, national and regional transport networks" (UNCRD, 2017b).

In response to these mandates, the secretariat prepared several publications on rural transport connectivity, including background documents for the Intergovernmental 10th and 11th Regional Environmentally Sustainable Transport Forum in Asia, held in 2017 and 2018 (UNCRD, 2017a; 2017c; 2018), two editions of the *Transport and Communications Bulletin*

² UNESCAP (2016a). Regional Action Programme for Sustainable Transport Connectivity in Asia and the Pacific, phase I, 2017-2021.

(UNESCAP, 2016b and 2017a), and also chapters in ESCAP’s biennial *Review of Developments in Transport in Asia and the Pacific* (UNESCAP, 2017b).

To consolidate these efforts, the secretariat convened an Expert Group Meeting on “Enhancing rural transport connectivity to regional and international transport networks” in Bangkok in July 2019. Representatives from Bangladesh, Cambodia, China, India, Kazakhstan, Nepal, Thailand and Viet Nam, international development organizations, and academic researchers presented information on their current rural transport policies, and discussed common challenges faced by governments in delivering their rural transport programmes.³ Participants agreed that there was a need to view rural transport as part of an integrated transport network, rather than as a separate entity. In this regard, the concept of “vertical connectivity” was seen as a potential framework for thinking about how people and goods move between different levels of transport networks, linking rural areas, towns and cities.

The idea of “vertical connectivity” is not new but finding ways to strengthen connectivity between transport networks is not easy. For a start, there is no agreement on what is meant by “connectivity”, which makes it difficult to design policies. Another obstacle is that transport network levels are often administered by different authorities, and it is unclear where responsibility for connectivity between networks lies. Furthermore, even if each administrative level is knowledgeable about the status of their own roads, this knowledge is still generally not in a form which can be easily shared. These, and other challenges, underline the need to approach connectivity in a comprehensive way.

1.2 Objectives of this monograph

Against this background, this publication aims to stimulate a wider discussion on what governments can do to enhance rural transport connectivity to higher level networks, and in doing so, make their rural transport networks more effective conduits for socioeconomic development. Its primary objectives are:

- to set out a case for why vertical connectivity is an important policy objective for transport policymakers at all levels, including rural, state and national;
- to review how different components of transport systems, namely infrastructure, services and nodes, contribute to this connectivity; and
- to examine how rural transport connectivity is being integrated into policymaking and financing decisions, and what kind of data is needed to support these processes.

This Monograph draws on previous ESCAP publications and documents; research published by the UK Aid-funded Research for Community Access Partnership (ReCAP); publications of the Asian Development Bank (ADB), World Bank, and other development organizations, and academic journals. It also incorporates many of the points raised during the aforementioned Expert Group Meeting.

³ Presentations made at the Expert Group Meeting can be viewed on the ESCAP website at <https://www.unescap.org/events/expert-group-meeting-enhancing-rural-transport-connectivity-regional-and-international>

At this point, it is important to note what the publication does not cover. It does not discuss the technical aspects of rural road design, construction and maintenance. There are many excellent publications and journal articles already available.⁴ Furthermore, the publication does not discuss inland water transport and inter-island shipping in detail, despite their importance for countries in the Asia Pacific region. This was due to a lack of reliable information on these modes in rural areas.

In the course of preparing this study, it became apparent that compared to urban transport, there is relatively little research being conducted on rural transport, particularly in Asia and the Pacific. Some organisations and projects, such as Research for Community Access Partnership and the Partnership on Sustainable, Low Carbon Transport (SLoCaT), are helping to fill the knowledge gaps around rural transport, much more efforts are needed, especially on the potential for new technologies to bridge the disadvantages faced by rural communities. The need for further research is discussed in the Concluding Section.

The rest of the Monograph is structured as follows:

- **Section 2** describes different dimensions of rural development in which vertical connectivity is becoming increasingly important;
- **Section 3** presents a simple conceptual framework for thinking about vertical transport connectivity;
- **Section 4** reviews policies on rural infrastructure connectivity and describes examples of how connectivity is integrated into policy and financing practices;
- **Section 5** discusses rural transport services and selected types of nodes which link network levels, including micro and macro level transport networks;
- **Section 6** reviews selected indicators of connectivity, with a focus on the Rural Access Index (RAI) and some innovative ways in which rural transport data is being collected;
- **Section 7** concludes and identifies priority issues for further research and cooperation.

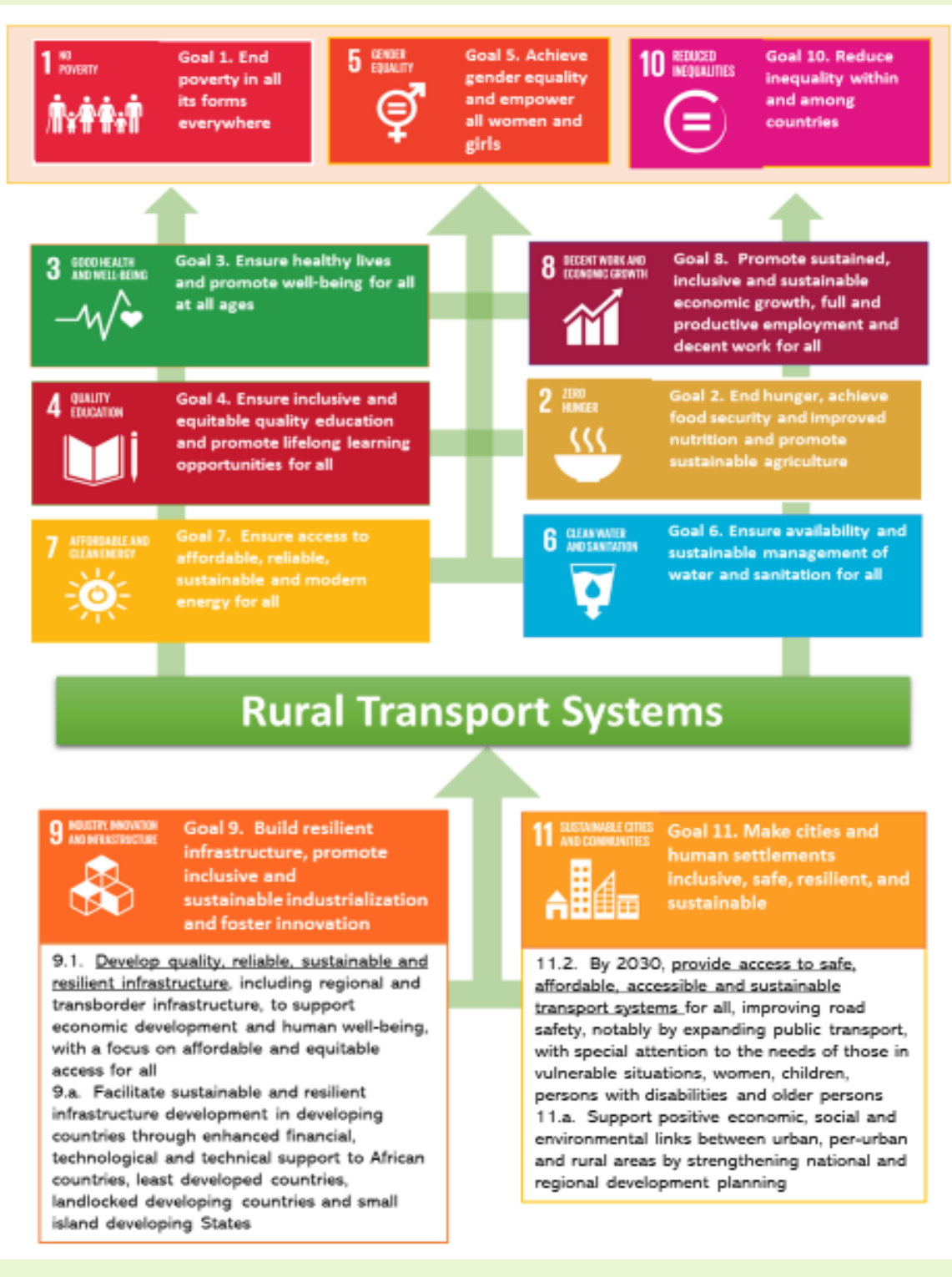
It is hoped that this publication will contribute to the ongoing discussions at the national, regional and global levels about how to improve access to transportation, enhance personal mobilities and raise living standards in rural areas. Improving rural transport connectivity will reduce the chances of people living in rural areas being “left behind” in the development process.

⁴ For guidelines on designing, constructing and maintaining rural roads, see the Overseas Road Notes published by the Transport Research Laboratory and the UK Department for International Development (DFID); World Bank technical papers on rural transport infrastructure (for example, Lebo and Schelling 2001); and Johannessen (2008).

Box 1. Rural Transport Systems and the SDGs

Some of the Sustainable Development Goals are not ends in themselves, but a means to an end. The development of rural transport systems are parts of SDGs 9 and 11, but they support a host of other SDGs. These SDGs, in turn, contribute to each other as well as to the overarching goals of reducing poverty (SDG 1), achieving gender equality (SDG 5), and reducing inequality (SDG 10).

Source: This study.





Source: Ashok K. Sarkar

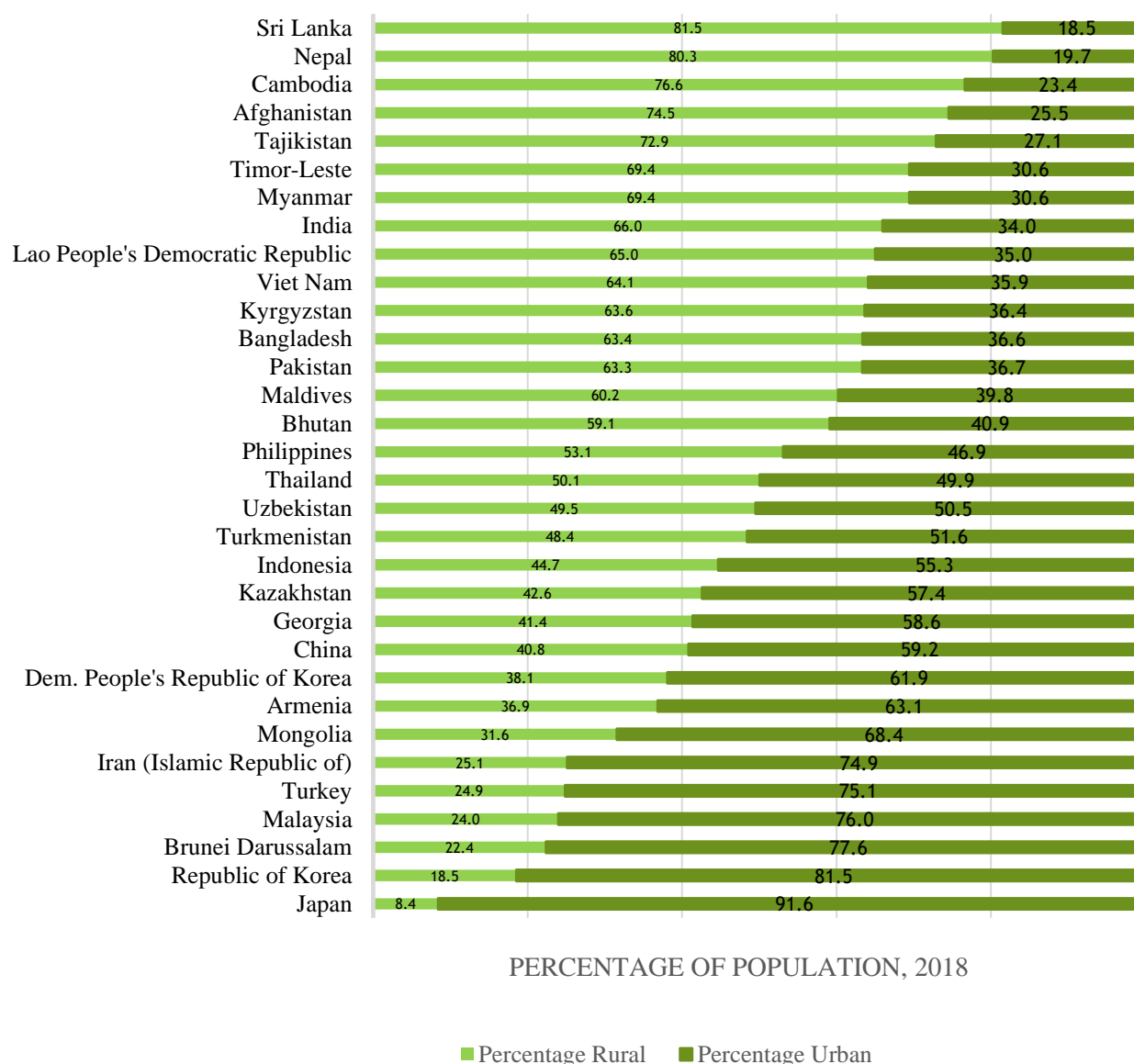
2 Why is rural transport connectivity to higher level networks important?

Rural areas across much of Asia are undergoing profound economic, social and demographic changes. Improvements in transport networks have made isolated areas more accessible, while Information and Communication Technologies (ICT) and mobile telephony have facilitated communication between these areas and towns and cities. More and more rural residents are engaged in socio-economic networks beyond their village boundaries. Not only goods and people, but ideas, values, cultural practices, and so on are moving, both physically and virtually, across multi-layered networks.

These trends have prompted organizations and researchers to reassess rural development from a broader perspective than ever before. For example, the United Nations Human Settlements Programme (UN HABITAT) argues that *urbanization* is a driver for *rural* development, and that governments should implement strategies to strengthen “urban-rural linkages” (UN HABITAT, 2017). Meanwhile, the Food and Agriculture Organization (FAO) and multilateral development banks are looking to agribusiness and sustainable food value chains as ways to connect agricultural producers to global markets. In academia, researchers are re-examining “global-local linkages” (Kammeier, 2012) and how these affect rural development, such as migratory flows and remittances, agricultural value chains, e-commerce, biofuel production, land-leasing agreements between countries and their impacts on local communities, and so on.

While migration from rural to urban areas continues in most Asian countries, a substantial proportion of the population is still classified as rural (Table 1). However, the boundaries between “rural” and “urban” areas are becoming more blurred. It is therefore important to reflect on how rural transport connectivity beyond rural areas can contribute to rural development processes.

TABLE 1. DISTRIBUTION OF RURAL AND URBAN POPULATION IN ASIAN COUNTRIES (% OF TOTAL POPULATION)



Source: United Nations (2018). World Urbanization Prospects: The 2018 Revision.

2.1 Changing patterns of agricultural production and distribution

Rural poverty is closely associated with the agricultural sector because a large proportion of the poor depend on agriculture for their livelihoods (IFAD, 2010; World Bank, 2007). Governments have implemented many measures to improve agricultural practices, such as by promoting new and improved seeds, investing in energy and irrigation systems, raising awareness about processing and storage systems, and other measures. At the same time, non-traditional agricultural exports (NTAEs) have become an important type of export for many

developing countries. Unlike traditional value chains which involve a large number of small retailers and producers, NTAEs are usually associated with modern agricultural value chains, which entail a greater degree of vertical coordination, consolidation of the supply base, agro-industrial processing and use of standards (FAO, 2010).

Proponents of agricultural value chains argue that “Poor agricultural producers often struggle to gain market access because they lack knowledge of market requirements or the skills to meet them. Furthermore, poor information flow and other obstacles in value chains prevent them from entering into new markets or reduce the benefits they obtained from entry” (Henriksen et al., 2010). Agricultural value chains are therefore seen to offer rural farmers access to bigger markets, and therefore a reason to grow beyond subsistence levels. However, participation in such value chains is determined by the ability of farmers to increase their scale of production, which in turn may be mediated by transportation and logistics systems. For example, Raballand, Macchi and Petracco (2010) present the links between the type of agriculture and rural infrastructure requirements in Table 2 below (adapted from Metschies, 1998). In theory, as agriculture becomes more mechanized, the scale of production increases and motorized vehicles start to replace Intermediate Means of Transport (IMT).

TABLE 2. RELATIONSHIP BETWEEN TYPE OF AGRICULTURAL PRACTICE, EQUIPMENT AND TRANSPORT REQUIREMENTS

Agricultural level	Required equipment	Agriculture type	Rural road and transport requirements
Subsistence agriculture (fields of up to 1 hectare per family)	Hoes, wheelbarrows, and shovels	Harvesting small fields using hoes, shovels, and hand trailers	Shovels and earth distribution for cross-section of earth
Cash crop agriculture	Oxen, bicycles, motorcycles, and motorcycle trailers (for most productive use)	Plowing by oxen	Transport to and from the field by bicycle trailers, transport to and from the markets by ox cards, motorcycles, or motorcycle trailers
Mechanized agriculture	Tractors, motorcycles, and motorcycle trailers	Plowing with hired tractors	Transport to and from the market with trucks, and to and from the field with tractors
Industrialized agriculture (on more than 30-hectare plots)	Heavy machinery and automation	Fully mechanized and partly automated harvesters	Roads for machinery and heavy trucks

Source: Raballand, Macchi and Petracco (2010), adapted from Metschies (1998).

Connecting rural areas to urban areas and beyond can support the commercialization of agriculture, but it should be noted that the impact of such interventions will be felt differently by different groups. For example, in countries where women are less likely to own motorized vehicles or have access to transport than men, female farmers may find that an improved road makes little difference to their abilities to access markets (UNCTAD, 2015). In general, however, reducing transport costs and broadening market access has been shown to encourage rural producers to expand the scale of production, and/or move into producing higher value-added goods. In Viet Nam, for example, improved roads encouraged farmers to switch from rice to higher value fruit production (although they also diversified because fruit production, which is less labour intensive than rice production, allowed them to take on non-farm work)

(Thanh and Tacoli, 2010). Another study from Viet Nam found that local road projects led to “transport-induced local-market development” (Mu and Van de Walle, 2011).

As mobile telephones and ICTs spread into rural areas, these technologies will transform how agricultural products are marketed and distributed. For example, researchers at Chiang Mai University are studying how infrastructural improvements to the North South Economic Corridor (NSEC) under the ADB’s Greater Mekong Subregion programme and the growth of online shopping in China could help Thai farmers expand high-value fruit exports to China (Box 2). In this regard, digital and physical transport connectivities are expected to influence each other, but it is too soon to say how their relationship will evolve.

2.2 Food security, food loss and food waste

Globally, the FAO reports that roughly one third of all food produced for human consumption is lost or wasted (FAO, 2011).⁵ This is why Goal 12 of the SDGs, to “Ensure sustainable consumption and production patterns”, includes the need to “halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses” by 2030 as one of its targets.

According to Lipinski et al. (2013), globally approximately 24 percent of food loss and waste occurs at production; 24 percent during handling and storage; and 35 percent at consumption. In South and Southeast Asia and in Sub Saharan Africa, the majority of food loss and waste is believed to occur at the production and storage stages. The transportation sector is involved in most stages of the food chain and is therefore a critical stakeholder in reducing food loss. In fact, many studies on post-harvest losses (PHL) focus on the losses which occur en-route to markets. Rosegrant et al. (2015), for example, estimated PHL for different geographical regions, different types of losses and different types of commodities, and then simulated the effects of potential improvements in harvest technologies and transport infrastructure on the amount of product reaching markets safely. Their simulation showed that transport infrastructure, and roads, could directly reduce the risk of PHL.

Storage facilities and distribution centres also play an important role, and although they are not seen as transport nodes per se, they interact with transport services to determine collection and distribution systems. A study in Bihar, for example, found that better road infrastructure contributed to increased use of cold storage facilities by potato farmers (Minten et al., 2010). Meanwhile, another study of food marketing systems in Bhutan found that the lack of collection sheds and inadequate storage and processing facilities were forcing farmers to harvest and sell all of their produce at the same time, thereby pushing the prices down (Kawai, 2018). In this regard, transport infrastructure and services from farms to markets should be planned in conjunction with nodes such as consolidation centres and storage facilities.

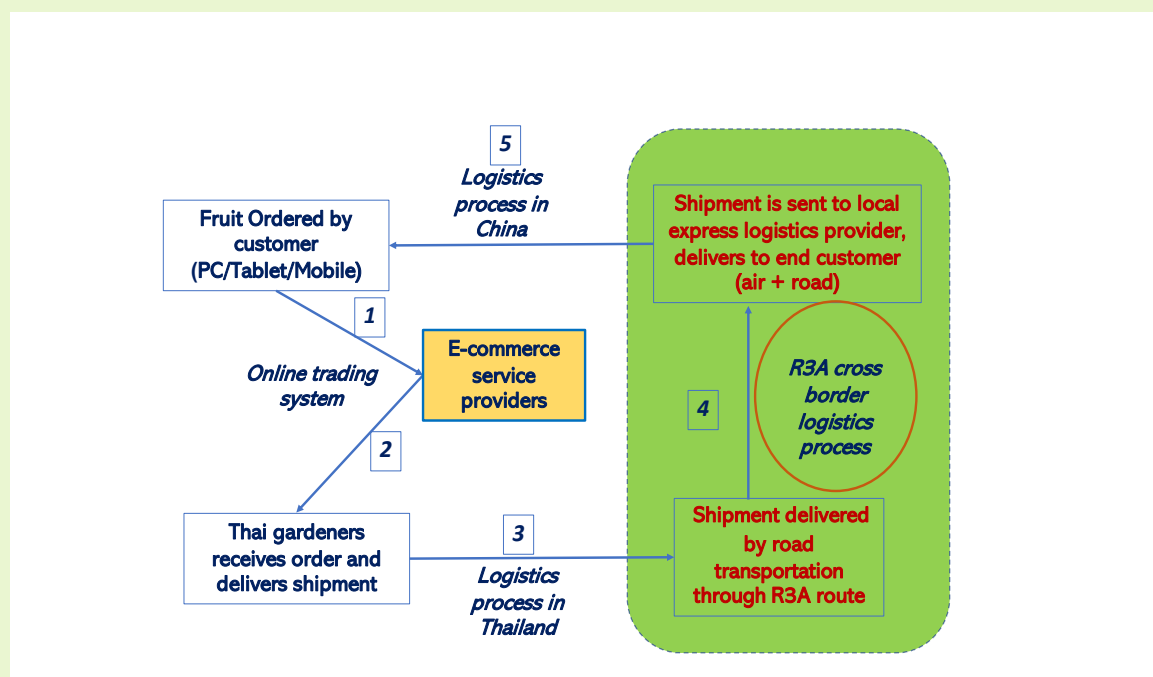
⁵ Food loss is food that is spilled, spoilt or lost or loses quality and value before reaching its final product stage, while food waste is food that completes the food supply chain up to final product stage, but does not get consumed because it is discarded (FAO, 2011).

Box 2. How infrastructural Improvements and e-commerce can expand opportunities for rural producers: the case of the north south economic corridor

The North South Economic Corridor (NSEC) links Yunnan Province of China, northern areas of the Lao People’s Democratic Republic, the Shan State of Myanmar, and northern Thailand. In 2017, the Governments of China and the Lao People’s Democratic Republic signed a Memorandum of Understanding to conduct a feasibility study of the construction of Huai Xai-Mo Han Expressway (R3A). This project along the Bangkok to Kunming expressway would reduce the distance between the two cities from 240 km to 180 km, and the time to only 1.5 hours. Furthermore, a high speed railway is currently under construction between Kunming and Mohan, and several Special Economic Zones (SEZs) and Free Trade Areas (FTAs) have been established such as the Mohan-Boten SEZ (on the border between China and Laos) and the Chiang Khong SEZ (on the border of Laos and Thailand).

Dr. Danaitun Pongpatcharatorntep, a researcher at the China Intelligence Center, CAMT Digital School, Chiangmai University, has studied the trade of Thai fruit exports to China for over a decade. Since the Belt and Road Initiative was announced by the Chinese Government, there has been a notable shift in routing preferences from the traditional shipping route (via Bangkok’s ports to Jiang Nan market in Guangzhou) to overland routes via the NSEC and the R12 route linking Thailand, Laos, Vietnam and China.

Furthermore, a softening of trade regulations has made it easier for Thai fruit exporters to trade via Laos. With the growth of online shopping in China and more digitally connected Thai producers, Dr. Danaitun sees potential for e-commerce to link small-scale Thai farmers in the northern part of Thailand with China’s vast market via the NSEC and Xishuangbanna Gasa International Airport in Hunnan Province, China.



Source: Dr. Danaitun Pongpatcharatorntep, “The role of R3A road and digital platform to promote Thai agricultural product into China market”, presentation made at the EGM on Rural Transport Connectivity to Regional and International Transport Networks, July 2019, Bangkok.

2.3 Mobility and access to diversifying rural livelihoods

While agriculture remains a critical source of employment in the Asia and Pacific region, its share as a proportion of GDP is declining steadily, with other sectors such as rural industries and services becoming more important (World Bank, 2007). In China, for example, rural enterprises grew rapidly from 1.5 million in 1978 to 23 million in 2006, creating 115 million new jobs; the OECD estimated that by 2006, about 40% of China's exports were being produced by rural enterprises, with light industry, textiles and clothing accounting for about half of the total output, followed by machinery, handicrafts and food products (OECD, 2009). Even in South Asia, the contribution of rural non-farm activities to rural employment and household income in the early to mid-2000s was estimated to be from about one third in Nepal and Pakistan, to more than half in Sri Lanka and Bangladesh (Dudwick et al., 2011).

These changes are partly driven by improved transport systems. Better roads, more transport services, and rising levels of vehicle ownership has made it easier for farmers to work part-time or seasonally while also maintaining or taking temporary jobs in nearby towns. Sharma and Chandrasekhar (2014) for example, estimate that in India in 2009-2010, some eight million workers commuted from rural to urban areas on a daily basis, while roughly 4 million commuted from urban to rural areas. Meanwhile, "multi spatial" rural households are becoming the norm - households made up of members who live in several different locations, with some staying at home while others work elsewhere, travelling on occasion, regularly or seasonally (Tacoli, 2002).

The expansion of Asia's metropolises is well-documented, but the fastest growth is taking place in the region's secondary cities. In 2015, it was estimated that only 14 percent of the region's urban population lived in megacities, while close to 50% live in cities and towns classified below 500,000 people (ESCAP, 2015). As these cities expand, they absorb the rural areas around them. Peri-urbanisation, or the development of mixed land uses outside designated city boundaries, is taking place across South and South East Asia, bringing both opportunities and threats to rural residents (Hudulah, Winarso and Woltjer, 2007). For example, farmers may sell their land to real estate developers and buy new land further away, only to find that there are inadequate transport links to bring their products into the cities. Yap (2019) observes that in peri-urban areas, private real estate developers may invest in roads connecting their new housing developments to primary roads, but those people living outside of these developments must rely on the government, who often take much longer to build secondary and tertiary roads. The extent to which newly urbanized rural areas can benefit therefore depends on the quantity and quality of transport infrastructure and ease of connectivity to new employment opportunities and markets.

Over the medium- to longer-term, the quality and reach of rural roads affect the relative prices of factors of production, including different types of labour and fixed assets such as land. For example, Khandker, Bakht, and Koolwal (2009) show that in Bangladesh, investments in rural roads increased wages. Meanwhile, a study of the Government of India's Pradhan Mantri Gram Sadak Yojana (PMGSY) program found that one effect of the program was the shift of rural labour from agricultural to wage jobs, and that this was more likely to occur the closer the villages were to the cities (Asher and Novosad, 2016). However, as noted by Escobal and Ponce

(2002), “greater accessibility to product and factor markets does not necessarily entails (sic) higher levels of welfare.... because household income generation capacity could be threatened by increasing levels of competition in the local market.” In other words, just as roads may enhance people’s access to other areas, they facilitate the movement of “outside” people into the newly connected areas.⁶

2.4 The growing potential of rural tourism

Tourism is one of the fastest growing sectors in many developing Asian countries, with Asia becoming the second most visited region in the world after Europe. Tourist arrivals grew on average by 7% per year between 2005 and 2016, with arrivals reaching 308 million international tourists (UNWTO/GTERC, 2017). What is remarkable is that China alone accounts for some 21% of global tourism receipts.

Recently, more attention has been given to the potential of rural tourism to provide additional income and jobs in rural areas. Sharpley (2002) outlines the potential benefits of rural tourism, such as economic growth, diversification and stabilization through employment creation in both new (tourism related) and existing businesses, trades and crafts; the creation of new markets for agricultural products; maintenance and improvement of public services; revitalisation of local crafts, customs and cultural identities; and improvement of both the natural and built environment and infrastructure. However, Sharpley also notes that there are different opinions as to the extent to which these benefits are realized.

Case studies conducted in selected Asian countries show that rural tourism can have negative environmental or social impacts on rural areas, but in other cases it can bring new economic opportunities (WTO/GTERC, 2017). However, these opportunities are not evenly distributed across the population. For example, qualitative study of Cu Lao Cham, a marine protected area about 20 km from Ho Chih Minh city, found that most respondents had been able to stabilize their income thanks to a variety of jobs in the tourism sector, such as shops, boat rides, and motorcycle services, but this had also exacerbated inequality as not everyone benefitted (Nguyen, 2019).

The internet and social media are helping to publicize even very remote rural areas as tourist destinations. However, access to these areas is dependent on transport links. With growth in international arrivals expected to remain high, connectivity from international gateways such as airports and border crossings to regional and local transport networks will affect the potential for rural areas to attract tourists.

2.5 Strengthening health supply chains and distribution systems

Transportation and distribution systems are an integral part of healthcare supply chains. While some healthcare commodities are locally procured, a large proportion is also imported from abroad. Reproductive health supply chains, blood supply chain, cold chains for vaccinations,

⁶ Escobal and Ponce (2002) analyze the effects of road rehabilitation work in Peru by looking at the household per capita income, household per capita consumption, and also the composition of household per capital income (agricultural self-employment income, agricultural wage income, non-agricultural self-employment income and non-agricultural wage income).

and many other aspects of health care involve moving goods from international gateways, such as maritime ports and airports, to warehouses and ultimately to health service delivery points.

The transport of vaccines in particular has received a great deal of attention. A recent country review of Effective Vaccine Management (EVM) by the WHO found that storage and transport shortfalls at the subnational level, coupled with poor road infrastructures, make it difficult to deliver vaccines in rural areas (WHO, 2018). Supply chain management is therefore a core component of health systems research, which looks at ways to minimize distribution and storage costs and avoid “stockouts” of critical medicines (MSH, 2012). Another aspect of supply chains which receive less attention is the time spent by health workers travelling to pick up medicines and supplies from warehouses. Reducing the burden of transport on frontline medical staff should increase the time available for them to treat people.

2.6 Enhancing resilience against natural disasters

Priority 4 of the Sendai Framework for Disaster Risk Reduction, “Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction”, calls for national and local level actors “To promote the resilience of new and existing critical infrastructure, including water, transportation and telecommunications infrastructure, educational facilities, hospitals and other health facilities, to ensure that they remain safe, effective and operational during and after disasters in order to provide live-saving and essential services (UNISDR, 2015, Para. 33 (c)). Indeed, the experiences of recent natural disasters demonstrate the vulnerability of modern transport systems, as well as their critical role in humanitarian responses to such disasters. Okumura and Kim (2018), for example, describe how different transport stakeholders, including car manufacturers, cooperated in the wake of the 2011 Great East Japan Earthquake. National governments need to be able to monitor the integrity of transport systems during and after a major natural disaster, and to design a disaster response system which involves all modes and all levels of transport.

2.7 Key observations

As the above discussion demonstrates, the linkages between rural areas and regional and international levels are relevant in a wide range of sectors. Not only are traditional products made in rural areas, such as agricultural produce and primary goods, travelling further to towns and cities, but non-traditional rural products are also becoming increasingly important in rural economies. Furthermore, new sources of livelihoods, such as temporary migration and tourism, depend on the efficiency of transport networks to be sustained. In this regard, rural transport connectivity requires close planning with other sectors, as well as between different levels. To think about how such planning can proceed, the next section presents a simple conceptual framework to capture the different components of the transport system.



Begnas Tal Lake, Pokhara, Nepal, 2016. Source: J. Yamamoto

3 Conceptual framework for rural transport connectivity

Much attention in the rural transport literature is directed to “first mile” and “last mile” connectivity, as these are seen as the “weakest links” in rural transport systems. However, with increasing volumes of people and goods moving between different network levels, policymakers also need to look at how the different levels of the transport network fit together:

“Improving rural accessibility is a local-level issue and requires a change towards a people-centred approach to identifying problems and solutions. However, the higher levels of the transport network are relevant in that they provide the connectivity by which goods, services and people move into and out of rural areas. Thus, improved rural access depends on a well-functioning transport system from top to bottom in order to reduce economic distance.” (ADB, 2007, p.i).

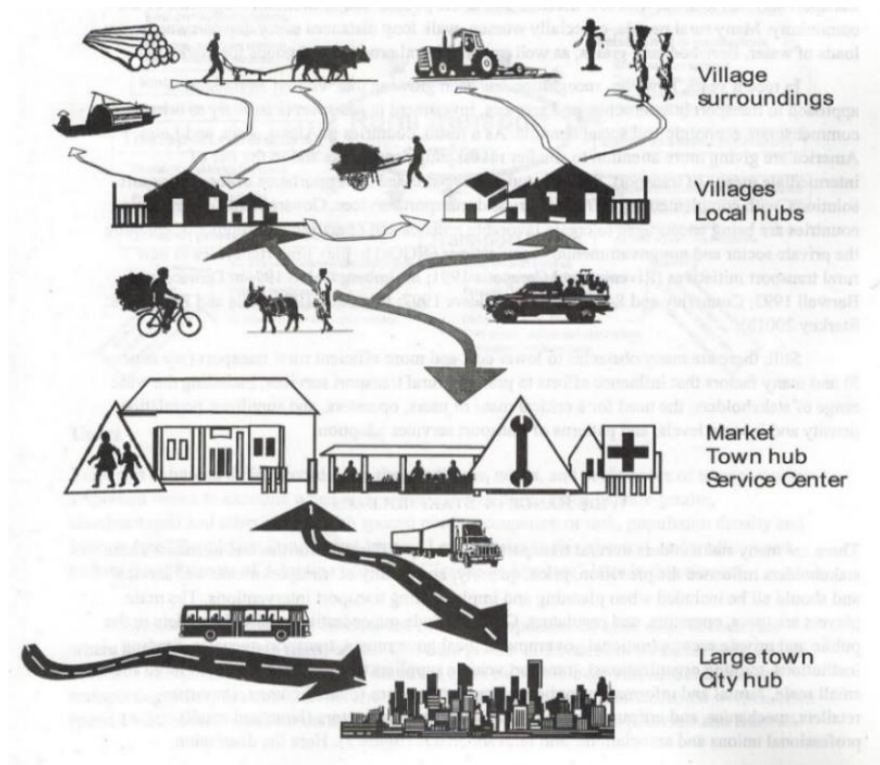
The phrase “connectivity” has become a popular catchphrase in the development literature, with definitions ranging from very vague to very specific (Box 3). The key to defining the concept is to understand “what” is being connected to “what”. ESCAP defines connectivity as “the capacity for areas and people to be connected, either physically or non-physically, through transport or communication” (UNCRD, 2017a). Meanwhile transport researchers often focus on the connectivity of a physical place or node, as in the case of Rodrigue who defines connectivity as the extent to which “flows of passengers or freight from a node can reach other nodes either directly (direct connection) or indirectly through another node(s)” (Rodrigue, 2017). The current section will examine the different components of transport systems which together affect connectivity.

3.1 Conceptualizing “vertical” connectivity

The movement of people and goods between different network levels is illustrated in Figure 1, which portrays a hypothetical rural transport network hierarchy (adapted from Starkey et al., 2002). It shows various individuals doing their daily tasks, such as plowing and collecting water. To access markets, town hubs or service centers, travel beyond the local village hubs becomes necessary and more elaborate modes of transport are used, including animals, non-motorized and motorized vehicles. Finally, modern transport systems (paved roads, motorized vehicles) carry people and goods to towns and cities.

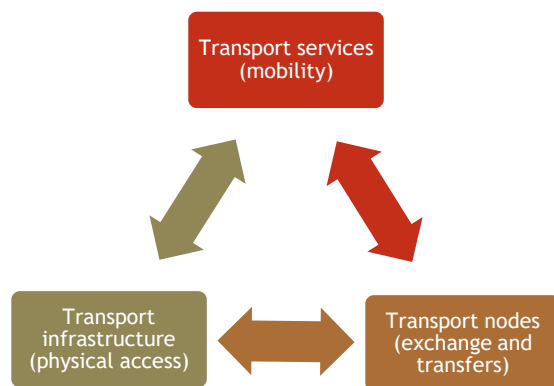
FIGURE 1. A RURAL TRANSPORT SYSTEM

Source: Starkey et al. (2002), p.11.



Transport infrastructure and services can be said to be the hardware and software of the transport system, while transport nodes are the locations where transport exchanges and transfers take place. Infrastructure can be seen as representing physical access; services as representing mobility; and nodes as representing sites of exchange and transfers. To achieve connectivity in an operational sense, governments need to address all three components (Figure 2).

FIGURE 2. COMPONENTS OF TRANSPORT



Box 3: Defining Connectivity

There is no standard definition of connectivity. Some of the different approaches found in the literature are described below.

Cooperative frameworks of connectivity: The Master Plan on ASEAN Connectivity 2025 refers to physical, institutional and people-to-people connectivity, while the Global Infrastructure Connectivity Alliance (GICA) is specifically focused on the energy, ICT, transport and trade sectors. Meanwhile, the Organisation for Economic Co-operation and Development (OECD) differentiates between “hard transport connectivity infrastructure” (physical infrastructure) and “soft transport connectivity infrastructure” (policies, regulatory mechanisms, institutional frameworks and operations that facilitate the functioning of the “hard” components) (OECD, 2018).

Transport/network connectivity: In the transport literature, a common way to define connectivity is to look at the extent to which “flows of passengers or freight from a node can reach other nodes either directly (direct connection) or indirectly through another node(s)” (Rodrigue, 2017). In the urban transport literature, network connectivity is defined as the number of roads or paths that connect one geographic area with another area. Dill (2004), for example, describes various measures of urban connectivity, such as density-based measures (street density, intersection density) and ratio based measures (for example, “link-node ratio”, which is an index comprised of the number of “links” divided by the number of nodes within a study area).

Service connectivity: Meanwhile, researchers interested in comparing airports and maritime ports have developed indicators of service connectivity, such as the Netscan connectivity model which captures the numbers of direct and indirect connections offered from each airport (SEO Aviation Economics website).

Spatial connectivity: In the geography literature, the relative spatial connectivity of geographic areas is sometimes assessed using gravity-based models, which relate the population size or the economic value of places and the volume of movements, speed of movements, flows, and so on, between these places (for example, Woollett et al., 2009).

Sources: GICA website; OECD (2018); Dill, J. (2004); SEO Aviation Economics (website); Woollett et al. (2009).

In order to conceptualize the different spatial levels of transport systems, it may be useful to set out the components in a hierarchy, as shown in Table 3 below. Broadly speaking, the different levels can be categorized as “macro”, “meso” and “micro” level networks. All three components (infrastructure, services and nodes) operate at the three levels (micro, meso and macro). Many discussions about rural connectivity focus only on micro-level connectivity. However, this framework is useful because it allows us to think about the relationships between the parts. In particular, the following four dimensions are of interest to this monograph.

- **Vertical Transport Infrastructure Connectivity:** represents the links between micro-, meso- and macro-level infrastructure networks (Cells A-D-G in Table 3). From village roads to regional and international networks, it should be possible to trace the infrastructure network between levels. Infrastructure Connectivity is taken up further in Section 4.

- **Vertical Transport Service Connectivity:** represents the services which operate on the different infrastructure networks (Cells B-E-H in Table 3). Some services only operate at their respective levels (for example, highway buses may only run on highways), but some services move between levels. In Asia, informal transport services play an important role in connecting otherwise disconnected services. Service Connectivity is discussed in Section 5.
- **Macro-infrastructure and micro-nodes:** It is often assumed that services move in a logical sequence between network levels. However, many macro-level networks (Cell A), such as the Asian Highways, also move through rural areas. Access to these macro-level networks can take place through local (micro) nodes, such as bus stops, local markets, and warehouses (Cell I). Focusing on such transport nodes, this “macro-to-micro” relationship is also discussed in Section 5.
- **Macro-nodes and micro-infrastructure:** Another dimension of connectivity can be explored via links between “macro-nodes” (Cell C), such as major railway and freight stations, dry ports, international border crossings, and so on, and the rural areas surrounding them. Access to these macro-nodes may depend on the quality of micro-level infrastructure (i.e. rural roads and pathways) (Cell G). This relationship is also considered as part of the discussion on nodes in Section 5.

TABLE 3. COMPONENTS OF TRANSPORT CONNECTIVITY, AT DIFFERENT SCALAR LEVELS

<i>NETWORK LEVEL</i>	<i>INFRASTRUCTURE</i>	<i>SERVICES</i>	<i>NODES</i>
MACRO LEVEL NETWORKS (national, regional, international)	A. National highways, primary roads, national railways, Asian Highway, Trans-Asian Railways	B. Long distance truck services, logistics services, railway services, long distance bus services	C. Dry ports, border crossings, railway stations, maritime ports, airports, bus stations
MESO LEVEL NETWORKS (inter-city, town to city, rural to urban)	D. Feeder roads, secondary or link roads; provincial roads, some trunk/ primary roads; some highways.	E. Medium distance truck services, local transport services, local buyers / brokers/ suppliers, privately owned transport	F. Urban wholesale markets, warehouses, transport hubs
MICRO LEVEL NETWORKS (intra-village, inter-village, rural to feeder roads)	G. Tertiary roads, rural roads; also trails, footpaths, small bridges. In the case of IWT, includes rural waterways, jetties and piers.	H. Privately owned transport (including intermediate means of transport), local transport services, local buyers / brokers / suppliers	I. Local markets, local shops, local warehouses, local transport hubs, bus stops, IWT piers

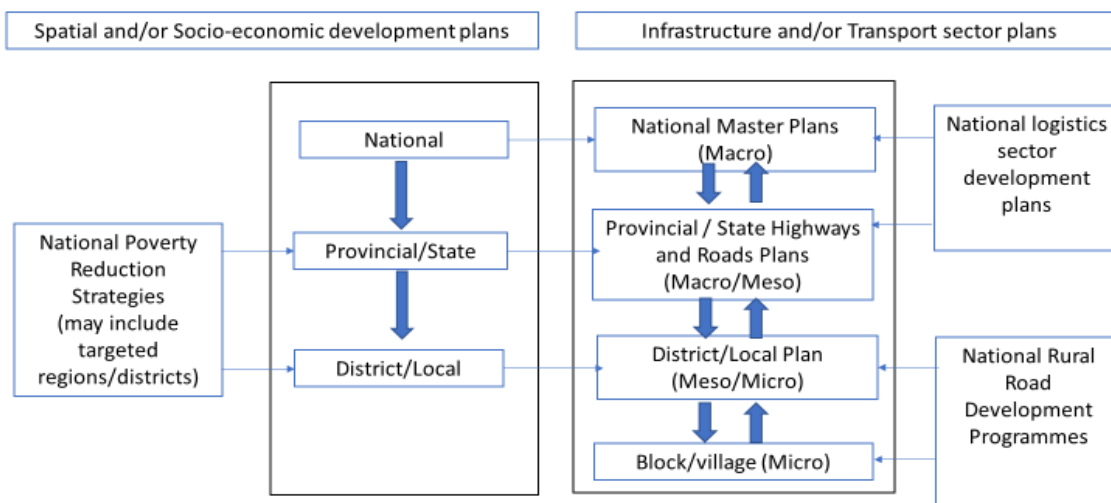
3.2 Rural transport connectivity within planning and policy frameworks

Most governments in Asia have transport sector policy frameworks. According to Nogales (2015), such a framework may consist of:

- a **transport sector policy** (a set of key targets and objectives for the transport sector in a country);
- a **national transport strategy** (a medium-term framework, perhaps up to 10 years, which covers financing, investment, regulation, and promotion of the transport sector, including reforms that may be required in order to implement policies); and
- a **transport sector master plan** (a long-term plan, often 20 years or more, containing a prioritized investment program consistent with the agreed strategy) (Nogales, 2015).

In theory, there should be coherence between the various parts, as well as across sectors (between socio-economic, spatial and sectoral plans) and vertically between national and subnational plans. In practice, the planning and financing of the rural transport sector takes place in a hybrid policy environment, with inputs from multiple levels of government (e.g. national as well as subnational and/or sectoral strategies) and sometimes from multiple actors (e.g. non-governmental organisations and external donors) (Figure 3).

FIGURE 3. RELATIONSHIP BETWEEN DIFFERENT TYPES OF NATIONAL PLANNING FRAMEWORKS



In this regard, policy guidance on rural transport can come from multiple policy documents, including:

- **National long- and medium-term economic development strategies**, such as Indonesia’s Masterplan for Acceleration and Expansion of Economic Development of Indonesia (MP3EI) and China’s Five-year plans;
- **National poverty reduction and/or rural development strategies**, which may identify specific regions or population groups where rural infrastructure investment should be targeted, such as Sri Lanka’s Gama Neguma Programme and China’s successive poverty reduction strategies;

- *National transport strategies and national transport master plans*, such as the National Transport Policy 2001 of Nepal;
- *National rural transport strategies* such as Bangladesh’s Rural Road Master Plan, Cambodia’s Rural Roads Construction, Improvement and Maintenance Program 2019-2023; China’s 4-B Rural Road (Better Construction, Better Management, Better Maintenance and Better Operation); India’s Pradhan Mantri Gram Sadak Yojana (PMGSY) programme, and Thailand’s Rural Road Development Plan;
- *Local level development or transport plans* such as Nepal’s District Transport Master Plans.

Many rural transport sector programmes use goals and targets as a tool to steer local government planning processes. Such targets are discussed further below.

3.3 Targets, goals and indicators

To guide planning and investment decisions at different levels of government, the central government sometimes sets quantitative targets. For example, both Japan and the Republic of Korea have time-based goals for connectivity: to be able to reach the national highway from anywhere in the country within 30 minutes in the case of the Republic of Korea, and within one hour in the case of Japan. Such targets are intended to level out inequalities in access to macro-level networks (Box 4). In middle- and lower-income countries, it is more common to set targets at the local level. Such targets include access to physical infrastructure (e.g. roads); transport services (e.g. bus stops); and facilities and offices (e.g. markets). Policy targets differ depending on who is being targeted, what is being targeted and how it is being measured (Table 4). These differences are elaborated further below.

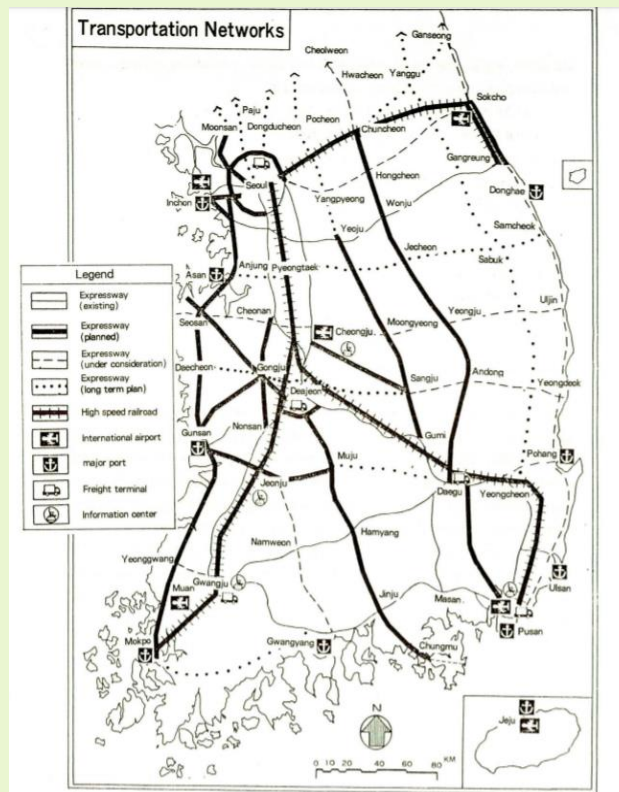
TABLE 4. TYPES OF TARGETS FEATURED IN RURAL TRANSPORT PROGRAMMES

	Measured by	Variations	Example
1) Access to transport infrastructure	Availability of rural road; distance or time to reach other roads	All-season vs seasonal (type of surface); targets to ensure minimum condition of road	The Rural Access Index (% of population who live within 2 km of road) is an indicator for SDG 9; Japan and Republic of Korea have time-based goals for access to expressway.
2) Access to transport services	Availability of transport services; distance or time to reach transport services, for example to the nearest bus stop	Access to public or private transport services	China has a goal of connecting all villages to rural bus services.
3) Access to specific destinations	Distance or time taken to reach specific types of destinations	Administrative offices; economic services (e.g. markets); social services (e.g. hospitals)	Nepal has a 30- minute target for children to walk to primary school. Viet Nam uses access to district centres as a criteria for planning.

Box 4. Republic of Korea's "Access to the highway in 30 minutes" policy target

From as early as 1968, when the first segment of the Gyeongbu (1st) Expressway from Seoul and Suwon was opened to traffic, the Government of the Republic of Korea has used transportation planning as a tool for supporting successive territorial development plans. Under the 1st Comprehensive National Territorial Plan (1972-1981), the goal of developing industrial complexes was supported by expressway development linking major cities and maritime ports.

By the 1990s, the strategy had shifted to regional territorial integration, including the development of a National Arterial Road Network consisting of 9 East-West Corridors and 7 South-North Corridors (also known as the “7 x 9 Master Plan” in the 3rd Comprehensive National Transport Development Plan, 1992-2001; see map). This grid-like design aimed to allow its citizens to “Access to the highway in 30 minutes from anywhere”, thereby benefiting farmers, fisherfolk, and other workers and businesses in rural areas. The network has been built up incrementally over time. Railway network development has also progressed in a similar way. In recent years, the government has put a greater emphasis on policies to enhance the use of the network rather than simply construction of roads, including better connectivity between modes, as well as measures to make the transport system more environmentally sustainable, safer and “smarter” through the application of intelligent transport systems.



Sources: Government of the Republic of Korea, The Third Comprehensive National Development Plan, 1992-2001 (p. 64); Ministry of Land, Infrastructure and Transport (MOLIT) website (www.molit.go.kr); Hwang Sang-kyu and Kim Gunyoung, Korea Transport Institute (2014). “50 Praxes for Better Transport in Korea”.

3.3.1 Whose access?

Some policy targets are defined in terms of the proportion of the population which has access to roads, services, etc. (such as the such as the Rural Access Index), while others count the

absolute number of people, such as in the case of China’s poverty reduction strategies, number of households, and numbers of villages. Most governments set a minimum population size to determine eligibility for investments. In India, for example, eligibility for funding from the PMGSY programme differs by geographic area: 500 persons and above in plain areas, 250 persons and above in special category states (desert and hill areas), and 100 and above in Integrated Action Plan (IAP) blocks.⁷ Other strategies target specific geographic regions, for example, very remote or poor districts.

3.3.2 What is being measured?

Governments and development banks often use the total length of newly constructed, upgraded or rehabilitated road as the benchmark to assess progress. For external donor-financed projects, additional transport indicators such as vehicle operating cost savings and time savings may also be collected. The benchmarks also specify the quality of the road being built, such as classification (capacity); type of pavement (i.e. all-season access or not); and condition of roads (good, fair, poor). In some cases, governments will use multiple indicators. China, for example, has both an annual aggregate rural road construction target and a (bus) service connectivity target for specific counties (Xinhuanet, 2018).⁸

3.3.3 What is being connected?

Some governments set targets in terms of access to specific destinations. These destinations are often nodes in the transport system, i.e. places where people transfer between services or exchange goods. They may be grouped into three broad categories:

Administrative offices of local government: Governments often tend to provide priority to all-weather roads connecting the local administrative headquarters, such as Thana (Sub-district) in the case of Bangladesh, the District Development Committee in the case of Nepal; or the District Centre in the case of Viet Nam. Such offices are important because they tend to be:

- where public services and rural commercial activities are concentrated;
- where civil society organisations are located;
- the “points of entry” for people from rural areas to transfer to “higher” (long-distance) transport services;
- the “points of distribution” from which inputs from larger urban areas are delivered to rural areas (ADB, 2007).

Growth centres and destinations important for economic activities: Governments in South Asia use the term “growth centres” to refer to destinations important for economic activities. Such “growth centres” may be further classified by size or availability of certain facilities, such as markets and veterinary service providers. The Government of India differentiates between “growth centres” and “rural hubs”: “growth centres” are an area of

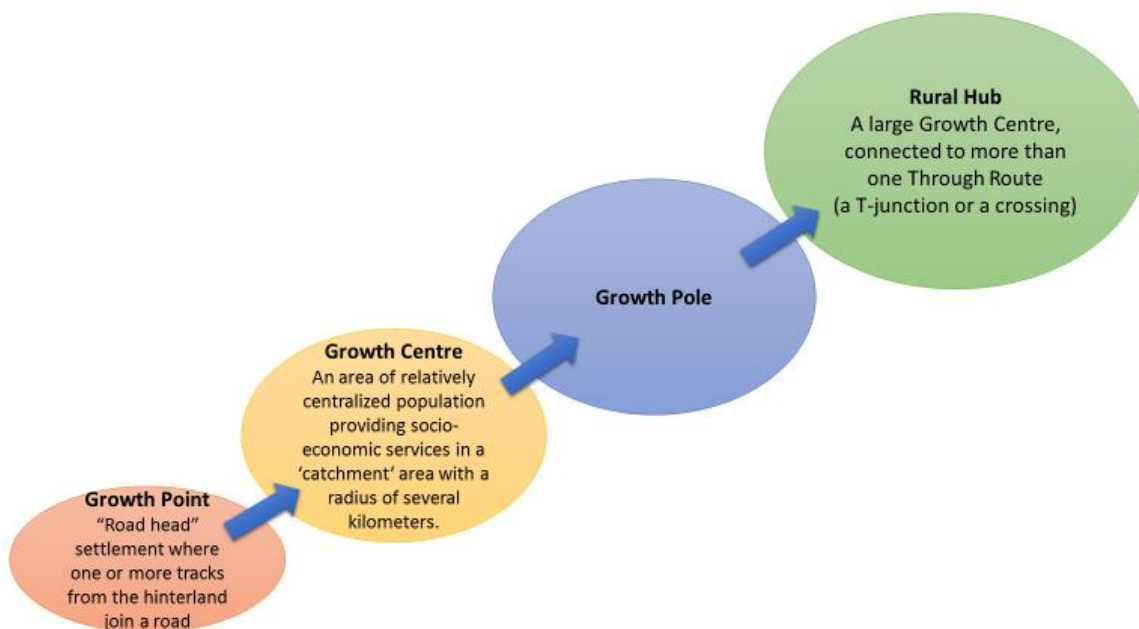
⁷ IAP blocks are tribal and “backward” districts which the Government of India provides special assistance to.

⁸ The Ministry of Transport of China announced in December 2018 that it had “built and renovated 250,000 km of rural highways this year, 50,000 km more than its plan for the year” and also expanded bus services to “over 7,000 more villages in China, exceeding the annual target of 5,000 more villages” Xinhuanet (2018).

relatively centralized population, providing socio-economic services and a catchment area with a radius of several kilometers, while a “rural hub” is a large growth centre, connected to more than one “Through Route” (see Figure 4).

Access to social services: In addition to economic facilities, governments also try to support access to social services such as educational facilities, medical facilities, and so on. It is also common for sectoral ministries, such as health and education, to have their own access targets based on zoning systems or population served. The Ministry of Education of Nepal, for example, set a goal for primary students to be able to walk from their home to school in 30 minutes. The question of where to locate newly facilities has a significant bearing on accessibility, but a lack of communication between ministries means that it is not always taken into consideration by transport planners.

FIGURE 4. HIERARCHY FROM "GROWTH POINT" TO "RURAL HUB"



Source: This study, based on the Government of India (2013).

While national strategies set the general direction, the development of the network is the result of implementing infrastructure projects. Thus to understand how connectivity is integrated into transport networks, it is necessary to look at how rural roads are selected, designed, and executed. The following section examines these processes in more detail.



Source: Timor-Leste Roads for Development Support Program (R4D-SP), ILO

4 Rural Infrastructure Connectivity Policies

The target of rural transport policies in most developing countries is infrastructure development. The emphasis of rural infrastructure development policies has evolved over time, with a shift from large-scale road construction programmes in the 1950s and 60s, to integrated rural development approaches in the 1970s and 80s, to more targeted road development projects in the 1990s. In line with governance trends in the 1990s, many countries began to systematically decentralize part of their infrastructure budgets to local governments. In response, countries started to adopt the Integrated Rural Accessibility Planning (IRAP) tool developed by the International Labour Organisation, which emphasized a more participatory approach to rural infrastructure development which reflected local people's priorities as much as the governments (see, for example, Nepal's experiences in Donnges, Ojha and Pearse, 2005). The 2000s saw a return to large-scale, national government-driven rural road programmes, such as the Pradhan Mantri Gran Sadak Yojana (PMGSY) programme in India.

The incremental nature of transport network development means that it is not easy for governments to coordinate and manage the development process. Infrastructure projects have long lifespans, often extending beyond the tenure of the politicians who approve their design and construction. How, then, is "vertical connectivity" between transport networks to be achieved? Drawing on experiences from the Asia Pacific region, this chapter will look at how countries are integrating connectivity into their rural transport infrastructure development, particularly at the planning stage. It will also briefly discuss road maintenance and some of the negative externalities of road projects.

4.1 Institutional arrangements for road administrations

As noted earlier, the definition of rural roads differs from country to country (see “Definitions and Concepts”). In Asian developing countries, it is common for roads to be classified according to more than one criterion, including:

- 1) function and strategic importance of the road;
- 2) number of users;
- 3) traffic level; and sometimes
- 4) differences in topography (for example, mountain roads).

Every country has its own system for administering its transport networks. In most countries, different classes of roads are administered by different authorities. Responsibilities for rural transport infrastructure may be divided between the transport ministry, public works ministry, and the ministry responsible for local governments. Some countries also have roads in rural areas which are administered by other ministries, such as forestry, irrigation, energy, mining, and others (sometimes referred to as “project roads”).

For example, Bangladesh’s road classification system divides the responsibility for different types of roads between the Roads and Highways Department under the Ministry of Road Transport and Bridges, and the Local Government Engineering Department (LGED) under the Ministry of Local Government, Rural Development (Table 5). As can be seen, the roads are classified according to their function in connecting different spatial units. Other countries may base their road classification system on the size of the population served; East Timor, for example, distinguishes non-core rural roads from core rural roads by setting a threshold of 500 people, including the rural population accumulated from other road links that connect to that road (Eqbali, Athmer, and Asare, 2017).

TABLE 5. BANGLADESH'S ROAD CLASSIFICATION SYSTEM

Responsibility	Type	Definition
Roads and Highways Department	1. National Highway	Highways connecting National capital with Divisional Headquarters, seaports, land ports or Asian Highway
	2. Regional Highway	Highways connecting District Headquarters (HQs), main river or land ports, or with each other not connected by national Highways.
	3. Zila Road	Roads connecting District HQs with Upazila HQs, or connecting one Upazila HQ to another Upazila HQ by a single main connection with National/Regional Highway, through shortest distance/ route.
Local Government Engineering Department (LGED) / Local Government Institutions	4. Upazila Road (UZR)	Roads connecting Upazila HQ with Growth Center(s) or one Growth Center with another Growth Center by a single main connection or connecting Growth Center to Higher Road System (1-3 above) through shortest distance/route.
	5. Union Road (UNR)	Roads connecting union HQ/s with Upazila HQs, Growth Centers or local markets or with each other.
	6. Village Road (VR)	a) Roads connecting Villages with Union HQs, local markets, farms and ghats (landing stations) or with each other; b) Roads within a Village.

Source: Government of Bangladesh (2010)

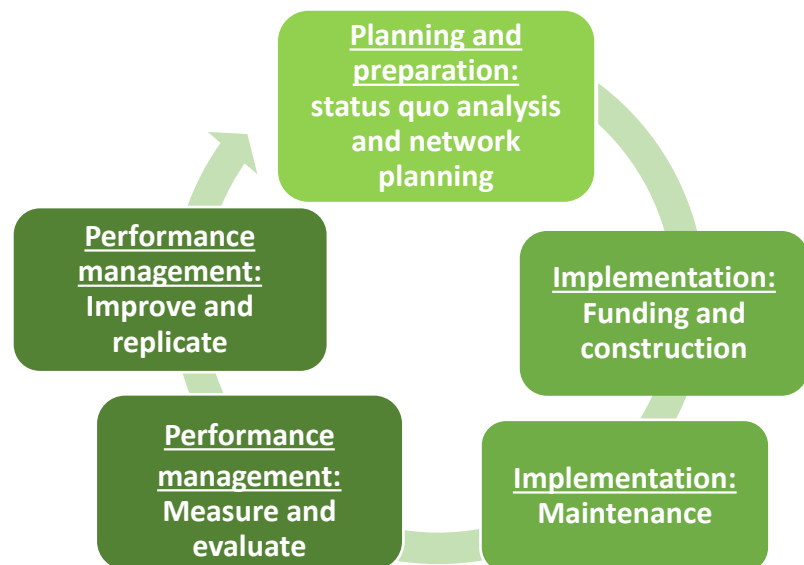
Other countries have a similar set-up, with a central agency focusing on local road infrastructure, such as the Department of Local Infrastructure in the case of Nepal and the National Rural Infrastructure Development Agency in the case of India. In other countries, rural roads fall within the purview of the road departments of provincial or state governments. The administrative structure and relationships between the different parts of government have implications for planning physical infrastructure connectivity between road network levels. This is further discussed below.

4.2 Integrating connectivity into the investment prioritization process

Rural transport infrastructure development programmes are financed from a variety of different sources. In some countries, they are financed through a cess (tax) on gasoline or diesel, while in others, they depend on loans and grants from multilateral development banks. Some use multiple sources: the Government of India uses income from a cess tax to pay for PMGSY, with co-financing from the World Bank. Meanwhile, private sector contractors who build the PMGSY roads are responsible for maintaining them for up to five years, after which the responsibility shifts to state governments (World Bank, 2014). Given the limited funding available, the issue of how resources are allocated is critical. Most countries therefore draw up an investment plan, which forms part of their transport sector strategies or master plans.

In theory, the first step in developing a transport network investment plan is to assess the status of the existing road network (Figure 5). Most governments now use highway decision-making software products such as Highway Development and Management tools (HDM-4) or similar variants such as the Road Economic Decision model (RED) for national network investment planning, which involves establishing a robust road asset management system. However, not all governments have a rural road asset management system. The data collected on rural roads is therefore quite basic, such as length of road segments, geometric data and road class, condition of roads, traffic levels (AADT), and so on), and not always up to date.

FIGURE 5. POLICY FRAMEWORK BASED ON RURAL TRANSPORT INFRASTRUCTURE PROJECT CYCLE



Source: This study, adapted from UNCRD (2017a)

Investment priorities should be based on the national objectives for the transport sector. At the same time, governments need a clear methodology for making investment decisions, which is both logically sound and aligned with national objectives, so that they can justify these investments to the public and their donors. It is difficult to justify rural road projects on economic criteria alone due to the low traffic volumes and low density of population. Thus, many governments and international donors also use non-economic criteria (e.g. access to health clinics, access to schools) in combination with traditional criteria (population served, traffic flows, vehicle operating costs, travel time saved) to prioritize investments.

Several methodologies have been developed to reflect this diverse range of criteria, and are often used in combination with each other (Lebo and Schelling, 2001; Bangladesh University of Engineering and Technology, 2018).⁹ In countries where a large proportion of habitations are still not connected by all-weather roads, the focus of rural transport programmes is usually on road construction. However, in many countries the focus is now shifting towards making better use of the road system, i.e. in raising the standards of those roads deemed to be of greatest importance, rather than simply building more roads. These roads are assessed according to the economic potential of the areas being connected, as well as the facilities and economic infrastructure which the road is connecting to. Three examples where connectivity and access have been integrated into rural transport investment policies are discussed below.

4.2.1 Bangladesh

Bangladesh has a long history of rural road development and now has one of the highest rural road densities in the world. However, challenges remain as funding for upgrading and maintenance cannot keep pace with the 6,000 km of roads added every year to the network (Bangladesh Country Presentation, 2019). To improve the decision-making process, a multidisciplinary team of researchers, engineers and government officials developed the Rural Roads Planning and Prioritisation Model (RPPM) as part of the ReCAP program (Box 5). The goal of the RPPM is to develop a “core” network of rural roads.

Prioritization methodologies were developed for three types of government interventions:

- Improvement: for example, converting an earth road to a paved road
- Further improvement/upgrading: Improvement of road geometric standards, raising embankments, widening pavement and/or road crest, and raising road embankments of an existing road.
- Maintenance of an already paved or partly paved road.

Unlike conventional methodologies which focus on traffic flows, travel time or distance, the RPPM adopts a network planning approach which focuses on local accessibility and connectivity with the greater region. The model combines both Cost Benefit Analysis and Multi-Criteria Analysis (MCA) to assist the Government in making investment decisions. The

⁹ Bangladesh University of Engineering and Technology (2018) provides a useful overview of the many different methodologies available for rural road planning and development.

criteria used to assess proposals include traffic volume, access to markets and social facilities, and connectivity.

Notably, connectivity is calculated by assigning points according to what the road connects to. As Table 6 below shows, roads providing connectivity to higher order roads are given a higher weight than others. This figure is fed into the aggregates scores, and then road project proposals are ranked in order of importance for the Core Network (see row 7 “Connectivity to higher roads / other centres” in Box 5).

TABLE 6. TYPES OF ROADS AND ASSIGNED SCORES UNDER BANGLADESH'S ROAD PRIORITIZATION SYSTEM

Level of connectivity	Road	Score
Part of core networks	<i>Upazila</i> roads that directly connect to national and regional highways of RHD, <i>zila</i> and <i>upazila</i> headquarters	100
	All other <i>Upazila</i> Roads	80
	Union Roads that connect <i>upazila</i> headquarters	50
	All other Union Roads	40
	Village roads that are part of core network	35
Not part of core networks	Village roads those are not part of core network	0

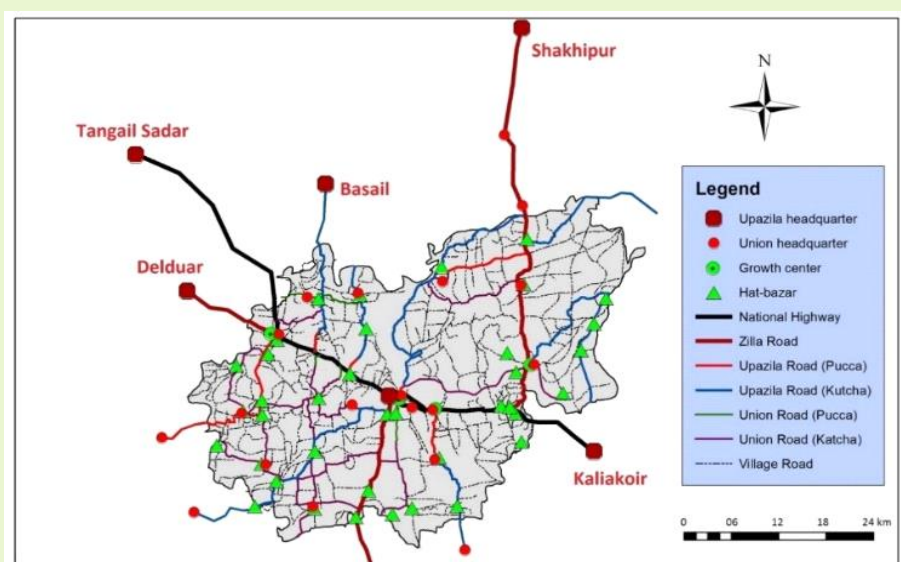
Source: Bangladesh University of Engineering and Technology (2018)

One of the advantages of the RPPM is that the data collected is input into a road database, which is linked to a reliable GIS system. Based on this data, the RPPM generates priority lists of roads with details of scores and analysis results. The relevant roads are also viewable on a map. Another unique characteristic of the methodology is that local stakeholders are invited to provide their views on the proposed road links, identify potential roads for further improvement/upgrading, and evaluate the connectivity status of the roads.

Box 5. Bangladesh's Network Plan

The goal of Bangladesh's Rural Roads Planning and Prioritisation Model (RPPM) is to develop a “core” network of rural roads. This network will include all *Upazila* and Union roads, and some important village roads managed by the Local Government and Engineering Department (LGED), and national roads which fall under the Roads and Highway Department. Unlike conventional methodologies which focus on traffic flows, travel time or distance, the RPPM adopts a network planning approach which tries to ensure local accessibility and connectivity with the region.

The team developed a prioritization tool which combines Cost Benefit Analysis (CBA) with Multi-Criteria Analysis (MCA). The criteria used for the MCA varies depending on the type of intervention (see table above). The scores for the criteria are standardized on a common scale and then added together for each road. Roads are then ranked based on these scores. The relative weights were calculated based on the outcome of an Analytical Hierarchical Process (AHP) survey of local leaders, LGED officials and experts.



List of criteria and weights for different interventions

Criteria	Description and measurement	Unpaved roads	Partly paved and HBB roads	Further improvement/upgrading	Periodic maintenance
1. Traffic volume	Average Annual Daily Traffic (AADT)	7.95	20.01	21.84	15.05
2. Surface type	Percentage of paved segments: <ul style="list-style-type: none"> BC+HBB+Other fully paved Fully HBB/Other paved BC+HBB+Other+Earth 	-	5.86	-	7.80
3. Road type	Upazila road is given highest priority, followed by Union and then Village Road.	-	11.83	7.86	14.15
4. Road safety	Is road safety an issue? Y/N	-	6.69	7.84	-
5. Facilities served	Education institutes, health facilities, industries, etc. (number and hierarchy of facilities)	18.65	15.02	9.54	14.85
6. Growth centres/rural markets served	Haats (markets) and bazaars are termed as Growth Centre and Rural Markets (number and hierarchy)	29.20	13.58	17.91	12.70
7. Connectivity to higher roads / other centres	Upazila level connectivity* Union level connectivity**	35.80	21.04	20.07	19.65
8. Local priority	Priority given by local representatives (points for high, medium and low priority)	8.40	5.97	14.93	-
9. Latest year of maintenance		-	-	-	4.30
10. Bus route	Presence of bus route along road (Y/N)	-	-	-	11.50

*If a road is important from the perspective of the entire Upazila. **If a road is important only at the union level. BC = Butiminous Concrete. HBB=Herring Bone Bond (brick pavement).

Sources: Bangladesh University of Engineering and Technology (BUET) (2018). Planning and Prioritisation of Rural Roads in Bangladesh, Final Report – Volume 1.; Presentations by Dr. Abdul Quium and Mr. Md. Ali Akhtar Hossain, Additional Chief Engineer, (Director, CReLIC), Local Government Engineering Department, UNESCAP Expert Group Meeting on Enhancing Rural Transport Connectivity to Regional and International Transport Networks, July 2019.

4.2.2 India

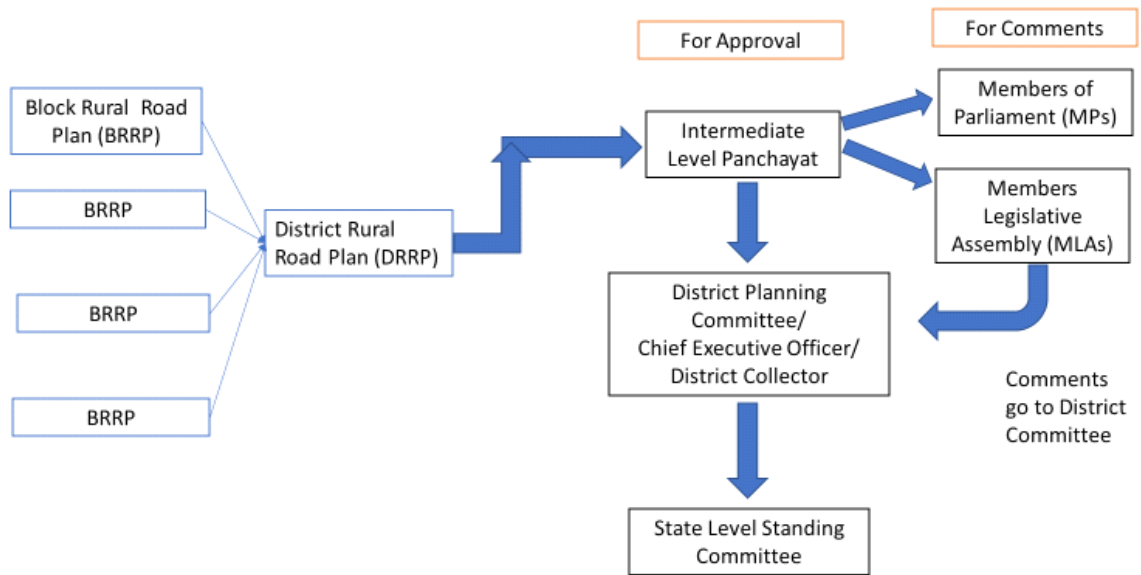
The Government of India's Pradhan Mantri Gram Sadak Yojana (PMGSY), launched in 2000, has resulted in the construction of approximately 600,000 km of rural roads up to 2019, connecting over 154,000 habitations (Sarkar, 2019). While the aim of the first phase of the PMGSY was to develop the Core Network of rural roads, the focus of PMGSY phase II, launched in 2013, was to increase the growth impact and efficiency of the network.

The revised system is based on the development of a District Rural Road Plan, which is a compendium of each District's existing road network and proposed roads for connecting unconnected habitations to already connected habitations and/or all-weather roads. Proposed road projects are selected based on their economic potential and role in facilitating the growth of rural market centres and rural hubs (Box 6). The Government classifies rural spatial areas as "growth centres" and "rural hubs" according to the type and number of facilities available (such as markets, public services, and so on) (Figure 4 above). These facilities are given points and then aggregated to assess where they fit in this hierarchy. Roads are then ranked in terms of priority for investment. As a result, most of the newly proposed road projects are for "through routes", which cater to large populations by connecting populations over a large area and which act as collectors of traffic from smaller roads, and major rural links (Sarkar, 2019).

The approval of the DRRP follows a step-by-step process which ensures a high level of transparency as well as checks on whether the proposed projects fulfil the government's selection criteria (for example, connectivity to growth centres). The procedure, shown in Figure 6 below, can be described as follows:

- Block level Rural Road Plans, or BRRPs, are prepared in accordance with the priorities spelt out by the District Panchayat (Blocks are the administrative unit below districts). They are then consolidated into the District Rural Road Plan (DRRP).
- The DRRP is sent to the Intermediate Panchayat for consideration and approval, and also simultaneously to Members of Parliament (MPs) and Members Legislative Assembly (MLAs), for their comments, along with a list of higher ranking growth centres, and all candidate through routes/ Major Rural Links.
- After approval by the Intermediate Panchayat, the Plans are placed before the District Panchayat for its approval. It is incumbent on the District Panchayat to ensure that the suggestions given by the Members of Parliament /Members of Legislative Assembly are given full consideration within the framework of the programme Guidelines.
- After approval by the District Panchayat, a copy of the DRRP is sent to the State Level Standing Committee (SLSC) for review.
- After approval by the SLSC, the final District Rural Roads Plan is sent to the State-level Rural Roads Development Agency (SRRDA) and the National Rural Infrastructure Development Agency (NRIDA) and becomes part of the PMGSY.

FIGURE 6. APPROVAL PROCESS OF PMGSY ROADS



Box 6. PMGSY II: Linking Growth Centres to the Rural Road Network

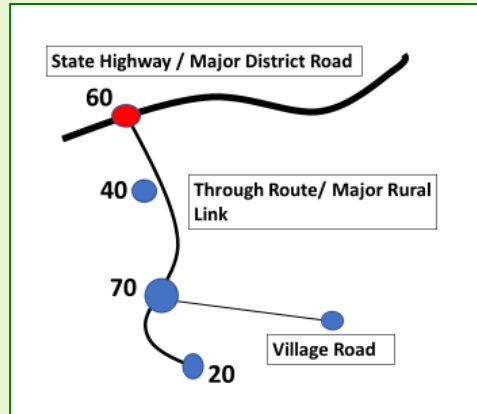
Phase II of the Government of India's Pradhan Mantri Gram Sadak Yojana (PMGSY) rural connectivity programme follows a decentralized network planning approach. To provide an objective method for comparing proposals for new road projects, the Government designed a point system for different criteria, including economic and social facilities (see table below). Based on the score, the priority assigned to the roads (in order from highest priority to lowest) is given as level I >80; level II= 70-80; level III = 60-70, and level IV = Below 60.

Identification criteria for Growth Centres and Rural Hubs

	Parameter	Category weight	Sub-category weight/s
A	POPULATION (as per 2011 Census)	50	
	A score of 1 for each 150-population subject to a maximum of 50		50
B	EDUCATIONAL FACILITIES (score of the highest category)	10	
	Primary school		2
	Middle school		3
	High school		5
	Pre-university course/10+2 institute		7
	Industrial Training Institute (ITI)		8
	Degree college		10
C	MEDICAL FACILITIES (score of the highest category)	7	
	Sub Centre / ANM Centre		2
	Primary Health Centre (PHC)		4
	Community Health Centre (CHC) / Bedded Hospital (and referral for PHC patients)		7
D	VETERINARY FACILITIES	3	
	Veterinary Hospital		3
E	TRANSPORT AND COMMUNICATION INFRASTRUCTURE	15	
	Railway station		4
	Bus stand		3
	Notified tourist centres		2
	Post-Telegraph Office, PCO/Bank/Regional rural banks		2
	One diesel/petrol authorized outlet 1		1
	Additional authorized diesel outlet 1		1
	Electric substation 11KVA		1
	Electric substation above 11 KVA 1		1
F	MARKET FACILITIES (cumulative score)	12	
	Mandi (based on Turnover)		7
	Warehouse / cold storage		3
	Retail shops selling agricultural inputs and items of daily consumption		2
G	ADMINISTRATIVE CENTRES (score of the highest category)	3	
	Panchayat HQ		1
	Sub Tehsil		2
	Tehsil / Block headquarter		3
		100	100

The methodology calculates a line score based on the cumulative score of the Growth Centres (calculated from the above table) which are directly connected by the candidate road, and higher order roads leading to such growth centers. These candidate roads need to be normalized for selection of roads to be upgraded subject to the Pavement Condition Index (PCI) and maintenance investment. For this purpose, a Utility Value (UV) of the unit road length is computed. This is done by taking the line score and dividing it by the proposed length for upgradation. The utility value is the growth score per unit length.

For example, the Unit Value of the Through Route shown in the figure below is calculated by adding up the score of the growth centres (20+70+40= 130) and dividing by the length of the road section, which is 10 km. Thus, the overall utility value is calculated as 130 / 10 = 13. Note that the score of the growth centre at the junction of the Through Route and State Highway/Major District Road (marked in red) is not added, as it is already located on an MDR/SH.



Sources: Country presentation by Mr. Rajeev Lochan, Joint Director (Projects & ADB), National Rural Infrastructure Development Agency, Ministry of Rural Development, Government of India at the UNESCAP Expert Group Meeting on Enhancing Rural Transport Connectivity to Regional and International Transport Networks, July 2019; Government of India (2013). Pradhan Mantri Gran Sadak Yojana (PMGSY) Programme Guidelines (PMGSY-II), August 2013.

4.2.3 Timor-Leste

Since 2012, the Government of Timor-Leste has been developing its rural road sector through the Roads for Development Program (R4D), co-funded with the Australian Government and supported through technical assistance by the International Labour Organization. Under this programme, a rural road inventory and GIS system was developed, which were then used to prepare the Rural Roads Master Plan and Investment Strategy (RRMPIS). Eqbali, Athmer and Asare (2017) document the process from the start of the project to the completion of the Rural Roads Master Plan.

What makes the Timor-Leste experience different from other countries is that the Government decided to use the Rural Access Index (RAI) of the World Bank as a benchmark indicator to plan its road investments. To date, it is one of a few countries which has incorporated the RAI systematically into its transport planning processes. At the start of the program, nearly 98% of the rural population lived within 2 kilometers of a road, but as many of these roads were not passable all season or were in poor condition, the RAI was estimated to be 49%.

The team therefore set the RAI (all-weather) at 90% by the year 2030 and worked backwards to identify the necessary investments needed for rehabilitation/upgrading and to maintain roads in good/fair condition. Subsequently, a rural roads investment strategy was formulated, which aimed to maintain core rural roads and to rehabilitate and reconstruct all other existing core

rural roads, improving the RAI by 2.7% up to 2030. The key principles and criteria in determining the investment strategy included:

- Prioritize the maintenance of maintainable core rural roads – i.e. protect what is there;
- Allocate minimum funding to ensure continued basic access to non-core rural roads;
- Continue developing capacity of local contractors and road authorities
- Take into account overall road connectivity considerations in directing investments in rural road rehabilitation works.

Timor-Leste’s experience suggested that the preparation of the Road Asset Management Strategy and Investment Plan before estimating the RAI allowed the team to get a more accurate estimate for the RAI. As the country lacked a road inventory prior to the project, the development of the road inventory and associated capacity building activities were an important part of the process (see Box 10 in Section 6). According to Eqbali et al. (2017), one lesson learned was that it would have been more effective if the Rural Roads Master Plan and Investment Strategy had been developed as part of an overall Roads Master Plan for all road classes, thereby allowing integrated planning and implementation that enhances road connectivity.

4.3 Road maintenance

Road maintenance and other measures to protect transport infrastructures are important responsibilities of governments. Maintenance is critically important if the maximum benefits of roads are to be realized: a poorly maintained high level road can have the same level of functionality as a lower-class road, affecting the integrity of the whole network. One assessment of rural roads in Bangladesh, for example, found that districts with *more* roads had a *lower* percentage of good roads (i.e. lower connectivity) due to lack of maintenance, while insufficient drainage left a large part of the feeder and rural road system unusable during the monsoon season (Faiz, 2012).

The importance of maintenance is often demonstrated during natural disasters, when the delivery of humanitarian assistance is thwarted by poorly maintained infrastructure. In a review of road maintenance practices in its member states, the Asian Development Bank also noted that poor maintenance increases the vulnerability of the road infrastructure to the effects of climate change (ADB, 2013). Due to the rapid expansion of rural road networks in some countries, maintenance costs are also ballooning.

Some governments have out-sourced routine maintenance to local communities living along roads. For example, under a World Bank project called the Local Road Asset Management Program Project (2015 - 2023) in Viet Nam, local women’s groups in 14 provinces signed contracts with the local governments to do routine maintenance in exchange for fees (Viet Nam country presentation). Such arrangements can be effective, but they can also introduce unexpected problems. In Myanmar, for example, an ADB study found that the government relied on voluntary labour contributions from people for routine maintenance. However, these villagers lacked skills, experience, and tools, and don’t follow required schedules (ADB, 2016). Countries may be able to find ways to improve their maintenance systems by sharing information on effective practices with other countries.

4.4 Mitigating negative effects while enhancing positive benefits

There is a substantial body of literature on the negative impacts of transport projects in rural areas, particularly (physically) divided communities; increase in traffic accidents and fatalities; air pollution from increased traffic; run-off from roads polluting waterbodies (Sheng, 1990); deforestation; transmission of diseases associated with increased traffic flows and truck drivers; and other effects. Kuruppu and Ganepola (2005), for example, look at different kinds of impacts, including psychological and emotional effects from displacement and loss of livelihoods, on people displaced by the Colombo Katunayake Expressway (CKE) and the Southern Transport Development Project, two large-scale highway projects which were implemented in Sri Lanka, (Kuruppu and Ganepola, 2005).

Meanwhile, road safety is a major issue and it is becoming a priority for many governments in Asia, where traffic-related fatalities and injuries are increasing year by year. Given that intersections between minor and major roads are more prone to traffic accidents, road safety should be considered when planning such junctions. Furthermore, public awareness and education on transport safety in rural areas are needed as motorized vehicles become more common.

To avoid negative effects from projects supported by their loans and grants, multilateral financial institutions have strict environmental and social safeguards. However, the same level of due diligence is often not followed for projects funded from domestic budgets and other sources. Further research is needed on how the negative effects of greater rural transport connectivity can be mitigated through better planning and design processes, as well as through greater participation of residents who can provide useful insights from the users' perspectives.

4.5 Financing of the development partners

The Asia and Pacific region is going through a boom in infrastructure development. The Government of China's Belt and Road Initiative (BRI) has injected new resources into regional transport network development as well as into stand-alone projects. As Box 2 discussed, these projects can affect rural development patterns by influencing rural producers' options and decisions. At the same time, organisations such as the Asian Development Bank (ADB), Asian Infrastructure Investment Bank (AIIB), Japan International Cooperation Agency (JICA), and Korean International Cooperation Agency (KOICA) continue to actively support transport infrastructure projects in the region. These institutions are in a unique position to assist governments in strengthening rural transport connectivity to higher order transport networks because they can integrate coordination mechanisms in their projects. The Asian Development Bank, for example, is positioning itself to expand rural transport sector activities under its 2030 Strategy (Box 7), with a focus on developing rural infrastructure in tandem with agricultural investments. Such multi-sectoral initiatives are likely to involve not only infrastructure, but also investments in services and transport nodes, such as storage and warehouse facilities.

Box 7. ADB's Strategy 2030 more investment in rural transport connectivity?

“Strategy 2030” sets out the Asian Development Bank’s strategic operational framework up to 2030 (ADB, 2018). Under this framework, the organization’s programmes will be guided by seven operational priorities. As shown in the table below, rural transport development contributes to all seven of the Strategy 2030’s operational priorities, particularly priority 5, “Promoting rural development and food security” which aims to improve market connectivity and agricultural value chain linkages in member countries, among other things.

Priorities	Typical Road and transport sector contributions
1. Addressing remaining poverty	<ul style="list-style-type: none"> Improving rural access and connectivity Regional connectivity Equitable access and mobility in cities
2. Accelerating progress in gender equality	<ul style="list-style-type: none"> Rural roads with community employment opportunities Consideration of safety and mobility for all Achieve targets to promote gender equality
3. Tackling climate change and building disaster resilience	<ul style="list-style-type: none"> Achieve climate change targets in transport projects Promote low emission approaches and modes Embed climate resilience in designs and maintenance
4. Making cities more liveable	<ul style="list-style-type: none"> Develop integrated transport plans Continue growth of urban transport sub-sector
5. Promoting rural development and food security	<ul style="list-style-type: none"> Improve market connectivity, focus on rural roads Re-strengthen rural transport focus, including links to other sectors Rural roads, tracks and waterways
6. Strengthening governance and institutional capacity	<ul style="list-style-type: none"> Support Developing Member Countries (DMCs) embedding infrastructure asset management Strengthen service delivery and improve operation and maintenance Utilize financial modalities that are best suited Build capacity and strengthen institutions Promote systems approach to road/transport planning, development, management and operations
7. Fostering regional cooperation and integration	<ul style="list-style-type: none"> Improving regional transport connectivity Improve connectivity between transport rural/urban transport networks and regional networks Support for regional programs

As a leading multilateral financial institution in Asia, increasing the ADB’s activities in rural transport development could potentially translate into significant and tangible improvements in rural connectivity. It is in a unique position to foster cross-country learning between governments on important issues, such as effective rural road asset management systems and the use of new technologies for monitoring progress in rural connectivity. As it also plans to continue large-scale transport network projects, it could enhance access to these networks by rural communities through measures such as service area development.

Sources:

- ADB (2018). Strategy 2030 – Achieving a Prosperous, Inclusive, Resilient, and Sustainable Asia and the Pacific. July 2018.
- Michael Anyala, “Strategy 2030: Implications for Rural Road Transport”. Presentation made at the UNESCAP Expert Group Meeting on “Enhancing rural transport connectivity to regional and international transport networks”, July 2019.



Rural logistics distribution vehicle in Rui An, Zhejiang Province, China. Source: Lichun Hu, Rui An Department of Transportation, China, 2019.

5 Rural Transport Service Connectivity and Nodes

A diverse range of rural transport modes and services can be found in the Asia and Pacific region. In many rural areas, non-motorized transport modes, such as walking, cycling and riding animals, are still the predominant mode for first/last mile connectivity¹⁰, while human and animal traction and agricultural machinery such as tractors, are commonly used to carry agricultural produce. Informal sector entrepreneurs also provide services, including trucks, pick-ups, ‘rural taxis’, motorcycles, bicycles, and animal-drawn carts (UNCRD, 2015). In Bangladesh, China, India, Pakistan, and the countries along the Mekong River, inland water transport systems are the main mode for riverine communities. Meanwhile, for island and archipelagic countries, ports and inter-island shipping services are the main transport mode for passenger and good movements.

While the number of privately-owned motorized vehicles is quickly rising across the region, transit services are still used by the majority of rural residents, particularly for medium- to long-distance trips. These include both public and commercial passenger transport services. Meanwhile, small-scale informal services as well as medium- to large-scale commercial freight transport services move goods to and from rural areas.

Information about rural transport services in Asia is relatively difficult to find. Studies and projects conducted under the ReCAP programme, including regional projects on rural transport

¹⁰ For rural transport, this is typically referred to as first mile, because it is the primary transport segment for agricultural produce from farm to nearest motorable road, rather than the last mile, which refers to the provision of goods/services to rural communities. In the current document, both aspects are relevant so “first/last mile connectivity” will be used.

service provision (Motorcycle Safety, Gender Mainstreaming, Rural Access Index, IMPARTS, First Mile, Satellite imagery and remote sensing) and national projects (social impacts in Afghanistan, IMTs in Pakistan) are yielding a rich body of data and insights.¹¹ This research is useful because the challenges of rural transport services in the Asia Pacific region differ in some ways from those identified in Sub-Saharan Africa (Starkey et al., 2013, and Porter, 2014). For example, Hine et al. (2015) note that the adoption of IMTs has been greater in Asia than in Africa and that motorcycles and 3-wheelers (tuk tuks, side cars, and so on) are often adapted to suit local conditions.

While some governments actively support rural transport services, they are generally provided by the private sector. Cook et al. (2017) note that “There has been concentration on roads but it has been predominantly left up to 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.” Nevertheless, governments play an important regulatory role for rural transport services and could also play a potentially greater role in financing these services. This should be in the government’s interest because the benefits from investment in infrastructure will only be realized when transport services become cheaper, quicker, more frequent or more reliable (Howe, 2004).

5.1 Rural passenger services

In most rural areas, short-distance passenger services which connect rural residents to local facilities are almost always run by private operators. These services include medium-scale private enterprises, such as buses, and individual services, such as taxis, motorcycles and rickshaws. However, low population density, long distances, difficult terrain, and relatively low income of residents, often make it difficult for rural transport operators to make a profit from regular transit services.

Recognizing that high transport costs can be a barrier for some rural residents to access services, several countries have introduced policies to help overcome this barrier. Policies often focus on price instruments, such as subsidies (to passengers, service operators, or both), or on regulations, such as licensing systems to control the number of operators or to maintain price ceilings on fares. In some countries, non-governmental organizations or civil society organizations are filling the gaps by providing rural transport services, but this seems to be more common in Africa than in Asia. Another recent trend across much of Asia is the rise of ride-hailing services, which have started to venture into rural areas. Some examples of these different types of rural transport services are described below.

5.1.1 Bus services

In China, the Government has made the provision of public bus services to rural areas a key target under respective 5-year plans. These bus services complement the rapidly developing rural highway system, which now links 80% of rural areas to urban areas. It is estimated that

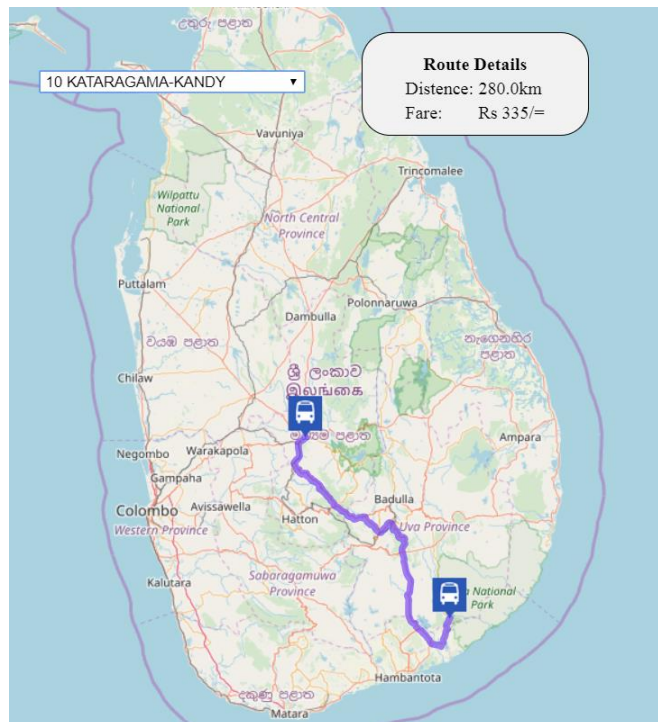
¹¹ See <http://www.research4cap.org/SitePages/Regional%20Projects.aspx> for further details. The project “Interactions: Maintenance-Provision of Access for Rural Transport Services (IMPARTS) in particular is studying how investments in low-volume rural road construction and maintenance affect rural transport services.

as of 2019, some 99% of towns and 96.5% of villages in China were linked by commuting buses. One of the government's current targets is make eligible villages accessible by commuter bus by the end of 2020 (China Country Presentation, 2019).

Sri Lanka's National Transport Commission provides budgetary support to several special bus services, including Gami Sariya services (public bus services linking rural areas to towns by providing concessionary services along routes considered to be economically unattractive; Sisu Sariya (concessionary public school bus services launched in 2005 to transport school children and teachers; there are currently 778 buses in service); and Nisi Sariya, which provides late night services in Colombo and its suburbs (Government of Sri Lanka, National Transport Commission website). The NTC website also allows users to select routes and get information such as maps, distance, fares and timetables for public bus services on these routes (Figure 7).

FIGURE 7. SCREENSHOT FROM SRI LANKA'S ONLINE BUS INFORMATION SYSTEM

The system provides information on distance, fares and timetables. See https://www.ntc.gov.lk/Bus_info/route_map.php



5.1.2 Public Health

In 1997, the Government of Nepal rolled out a Safe Motherhood Programme (*Amma* program) across the country. The programme focused on three aspects: 1) promoting birth preparedness and complication readiness, including the availability of funds, transport and blood supplies; 2) encouraging institutional delivery; and 3) expanding 24-hour emergency obstetric care services at selected facilities in every district. As the cost of transport was discouraging pregnant women, particularly those living in the mountain and hill regions, from visiting and giving birth in public health posts, the Government introduced a transport subsidy of 1500 Nepalese rupees (roughly US\$14) to women to deliver at health facilities. Despite these incentives, a recent study in Mugu, a remote Western district of Nepal, found that mothers still

reported transportation difficulties, such as travelling during labour, having to walk long distances and use public transport, and transport costs. The study therefore suggest that additional measures need to be tailor-made for remote areas, such as emergency air-ambulances and training more skilled birth attendants to assist home deliveries (Joshi et al., 2016).

In Africa, many international NGOs and civil society organisations have tried to address gaps in rural transport service, particularly to support access to health clinics and schools. For example, in Malawi and Zambia, an NGO called Transaid works with local communities to provide bicycles and motorcycle ambulances. Meanwhile, the Partnership for Reviving Routine Immunisation in Northern Nigeria/ Maternal, Newborn and Child Health Initiative (PRRINN/MNCHI) worked with the National Union of Road Transport Workers to train taxi drivers to provide emergency transport to women in labour. Unfortunately, there is limited information on the role of non-governmental organisations and civil society groups in providing rural passenger services in Asia. More research is needed to shed light on this important subject.

5.1.3 Mobility as a service

In several Asian countries, ride-hailing services have grown at a remarkable rate. As Table 7 shows, there are a variety of companies now operating across the region. Some companies are primarily motorcycle-taxi services, but many are now offering other types of transport modes as well as entering new markets such as food-delivery, package delivery, logistics, payment services, and even massages (“lifestyle services”). A report by Google, Temasek and Bain and Company estimated that the number of active ride-hailing service users in South East Asia alone has risen from 8 million in 2015 to 40 million in 2019, a factor of 5 (Google et al., 2019).

TABLE 7. SELECTED RIDE-HAILING COMPANIES ACTIVE IN ASIA AND THE PACIFIC

Name	Year founded	Countries in Asia Pacific region where operating	Est. number of drivers
Didi	2012	Several cities in Australia, China (particularly for bike-sharing), Hong Kong, China;	31 million (2019) (1)
Uber	2009	Australia, Bangladesh, Hong Kong, China; India, New Zealand, Republic of Korea, Sri Lanka and Taiwan; also food-delivery and high-end taxi services in Japan.	3 million (2018) (2).
Grab	2012	Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam.	2.8 million (2019) (3)
Gojek	2010	Indonesia, Philippines, Singapore, Thailand and Viet Nam	2 million (2019) (4)
Ola Cabs	2010	Australia, India, New Zealand, and UK (auto rickshaws)	550,000 (2016) (5).

Sources: (1) CNBC. (2) Uber.com. (3) Fortune.com. (4) Gofigure.go-jek.com. (5) Statista.com.

New types of services such as ride-hailing still face the same obstacles to profitability in rural areas: low population densities, long distances, poor quality roads, and so on. However, as Table 7 shows, the numbers of drivers in the sector are expanding rapidly, which may extend the reach of services into peri-urban and even rural areas. Furthermore, heavy competition has led companies to actively look for additional ways to make money. Some observers note that Grab and Go-jek are bringing financial services to areas outside cities where more traditional

operators, such as banks, have a limited presence. Their drivers are offering non-transport services such as e-commerce or cash card top-ups through their digital platforms (Deng, 2019). Another article reports that Indonesia's national airline, Garuda, is discussing the possibility of delivering goods ordered on Go-jek's app to the many different islands across the country (Techinasia.com). In these ways, there may be scope for ride-hailing services to "disrupt" rural transport systems, especially if there is convergence between these services and other modes or with other services.

5.2 Rural logistics and agricultural value chains

The capacity and quality of infrastructure greatly influences the kind of freight services which can operate. A paved road, for example, which allows trucks to collect produce from remote areas, may make it economically feasible for agricultural traders to operate. The quality of road also influences vehicle operating costs, transit times, and other factors affecting the turn-around of services and therefore their profitability.

It is therefore generally assumed that if roads are built, then motorized traffic will increase over time, more transport services will be available, and transport costs will go down. Studies also suggest that the construction of roads can lead to lower transport costs, either through savings in operating costs for existing transport operators, or through an increase in the number of operators, leading to a more competitive market. A recent study using data on India's PMGYSY Program found that better roads had reduced transport costs, which in turn brought down prices of agricultural inputs (Asher and Novosad, 2016). However, transport costs do not always go down, because they are determined by a myriad of factors. For example, the level of competition has a large bearing on how prices are set, and competition itself depends on the openness of the market. A critical mass of users, operators and suppliers of transport services is required to foster a healthy services market (Ellis, Hine and Ternell, 2002). It is also common to find local transport markets dominated by "cartel" like informally organized transport organizations (Hine, et al. 2015). Where competition in the transport sector is unregulated (as in the case of monopolistic or oligopolistic freight services), the benefits of reduced transport costs may not translate into lower passenger or freight fares.

Another reason why rural services are sometimes costly is because where road condition is poor, vehicle operating costs (VOCs) are typically higher, and as a result service providers increase their prices to cover the additional cost of fuel, vehicle maintenance and additional repairs. For example, in Pakistan, operators were found to add a 50-100% premium for rough roads (Essakali 2005, as cited in Sieber, 2009). An earlier study of rickshaw operating costs in Bangladesh found that rickshaw drivers charged more than double to operate on an earth road than on an asphalt road (World Bank 1999 and 1996, as cited in Lebo and Schelling, 2001).

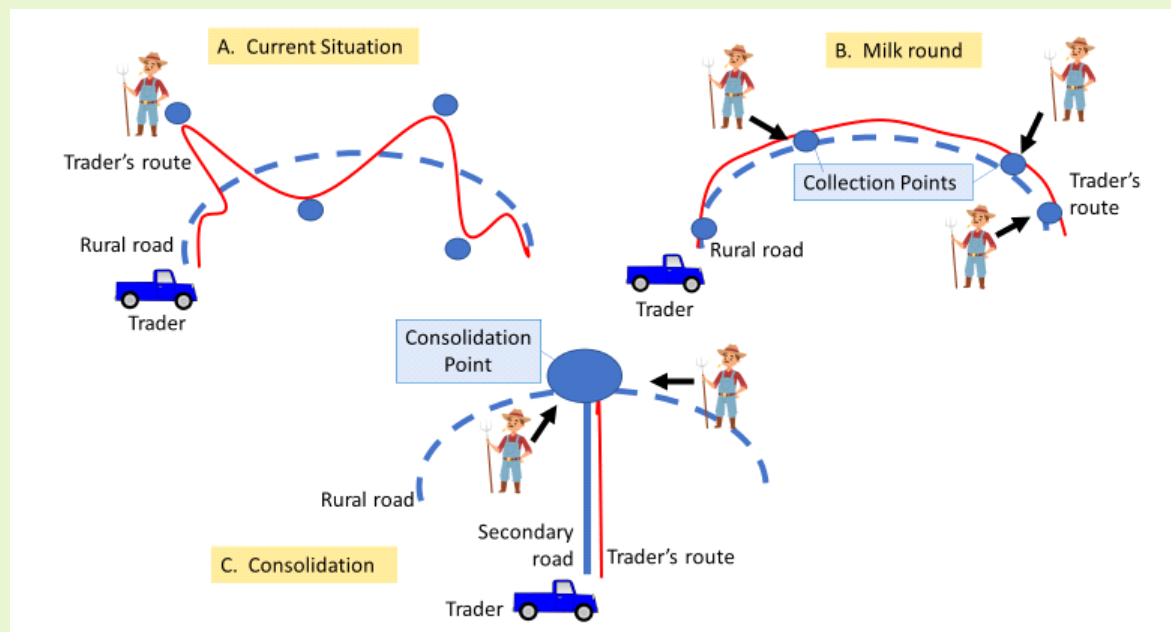
At the local level, the way in which products are collected and consolidated from farmers affects the level of profitability for middlemen and transport service operators, and therefore their willingness to transport the goods. This was demonstrated by Raballand, Macchi and Petracco (2010), who studied three different options for organizing the pick-up of produce from farmers. The consolidation of the product at a point on the main road, as opposed to picking up at the farmstead, was found to reduce the transport operator's costs and therefore make it

profitable to collect from this area (Box 8). This was one reason why the study argues that strengthening feeder roads may be more beneficial than building roads to all homes.

Although most governments play a minimal role in supporting rural freight services, some are actively providing support to the agricultural sector and to farmers and fishers in particular.

Box 8. Different Load Consolidation Models and Implications for rural road planning

According to Raballand, Macchi and Petracco (2010), the way in which consolidation points are organized has a direct bearing on the likelihood of farmers to produce beyond subsistence levels. They describe three scenarios: a) the current situation, b) “milk round”, whereby the trader drives along the rural road, and farmers bring their produce to the collection points; and c) the “consolidation” model, whereby both traders and farmers meet at a designated consolidation point, which is connected to the rural road by a motorable secondary road.



Assuming that the trader's truck runs 20 kilometers to the first village and that 4 villages are situated 3 kilometers from the road, the study estimates that the trader must travel 104 km under the current model; 80 km under the “milk round” model; and 40 km under the “consolidation” model. The consolidation model therefore provides the greatest savings. The study argues that this model will result in increased volumes in transport, increased numbers of rotations (because of more rapid turnover), and better road conditions, leading to more competition and falling transport prices.

Source: Adapted from Raballand, Macchi and Petracco (2010)

This includes policy interventions directed at improving transport services and reducing risk for farmers. Some examples from the region are given below.

The Malaysian Government has been working with the Farmers Association to support 400 collection centres and 40 distribution centres, as well as farmers' markets, in order to improve the collection and distribution of agricultural produce (Hine et al., 2015). The Government also runs small and medium trucks (2.5 to 12 tons) to collect and distribute produce. Efforts to support marketing and logistics systems in the agricultural and fisheries sectors were stepped up under the Ministry of Agriculture and Agro-based Industry's initiative to try to reduce

farmers' dependency on "middle-men" (Suhaimie et al., 2015). Support for rural logistics is one of the main components of this program. A separate project was started in 2011, which provided grants and microcredit to farmers to purchase motorcycle sidecars for moving their produce (Hine et al., 2015).

In China, the Government has embarked on an ambitious plan to build a three-tier (county, town, village) logistic freight network. In 2019, an estimated 65% of rural areas were linked to this freight network (China Country presentation). Part of this initiative has been to expand cooperation with the private sector. Local governments across the country have signed partnership agreements with e-commerce giant Alibaba to support the development of "Taobao villages" (Box 9). The main objective of this initiative is to link rural producers to China's massive online marketplace. Participating villages also benefit from various other services such as training and logistics support. As a result, the number of "Taobao Villages" has rapidly grown from 20 in 2013 to 3,202 in 2018 (Luo Xubei, World Bank Blog).

The Government of India introduced a subsidy in 1971 to support industrial development in the country's hilly, remote and inaccessible areas, namely in the Northeastern district. The

Box 9. E-Taobao Villages and the development of Rural Logistics in China

China has the largest online market in the world. To tap into this market, local governments have signed partnership agreements with Alibaba, China's largest e-commerce company. Alibaba offers an online shopping platform, or "Rural Taobao", to link rural producers to urban consumers. According to Li (2017), the "Rural Taobao of 2016 hopes to establish both physical and virtual e-commerce platforms for online transactions, and to build multifunctional service centres that offer villagers a wide range of online services, including education, medical services, and travel, that organise various e-commerce training programs for interested rural e-tailers, and that provide cultural/social services to the socially disadvantaged in villages."

One of the major barriers for rural producers is the small scale of production. By integrating modern logistics practices such as consolidation centres or nodes into the network, the "Taobao Village" model allows these operators to benefit from greater scale economies as well as to balance the uneven flow of agricultural inputs and exports of produce (ADB 2017). The involvement of Alibaba may also lead to a greater uptake of electronic payments systems, which may help bring down transactions costs.

Dependence on a single e-commerce company can increase risk for both producers and government officials, especially as Alibaba can determine the conditions for participating producers (such as the size of the commission). However, E-Taobao has shown that when introduced at scale, such interventions can potentially overcome some of the disadvantages facing rural producers. Other countries such as India are currently studying this model.

Sources:

- ADB (2017). Promoting Logistics Development in Rural Areas.
- Li, A.H.F. (2017) E-commerce and Taobao Villages - A Promise for China's Rural Development? *China Perspectives*
- Luo, X. (2018). In China's Taobao villages, e-commerce is one way to bring new jobs and business opportunities to rural areas. World Bank blog. November 22, 2018. <https://blogs.worldbank.org/eastasiapacific/china-s-taobao-villages-e-commerce-one-way-bring-new-jobs-and-business-opportunities-rural-areas>

subsidy covered the costs of transporting raw material and final products to/from the factory or site of production and a designated railhead (Hine et al., 2015). The government replaced the Transport Subsidy Scheme 1971 with the Freight Subsidy Scheme (FSS), 2013, until it was discontinued in 2016. Under these schemes, all eligible industrial units could apply for a transport subsidy for the transport of finished goods through the railways, inland waterways or scheduled airlines (in the case of the islands) for five years from the date of starting commercial production and operation. In March 2019, the Government announced a new scheme called the Transport and Marketing Assistance (TMA) scheme, which will reimburse agricultural exporters of certain products for a portion of freight charges. The scheme targets the cost of international freight in particular, but only containerized products. The scheme is expected to provide a boost to India's agricultural exports.

5.3 Role of transport nodes

The nodes which link transport services and infrastructure together are an integral part of every transport system. The term “node” is an umbrella term describing any points within a network which marks the beginning and end of a transport link. Transport nodes can be as small as the local village market, and as large as the capital city. In the case of passenger transport, they may take the form of bus stops, railway stations, or other destinations along a transport network, while for freight transport they include all physical spaces where goods are transferred, consolidated, or distributed.

In the past, the main criteria for the identification of the regional networks such as the Asian Highway and the Trans-Asian Railway included: (a) capital-to-capital links (for international transport); (b) connections to main industrial and agricultural centres (links to import origin and destination points); (c) connections to major sea and river ports (integration of land and water transport networks); and (d) connections to major inland container terminals and depots (integration of rail and road networks). The goal was to develop networks to connect these major nodes to each other. However, as was briefly discussed in Section 3, the impacts of these networks are not limited to these major nodes, but also affect rural areas along these networks (i.e. *macro-infrastructure and micro-nodes*, such as roadside markets). There may also be scope for improving access to these major nodes by people in the immediate vicinity or nearby (i.e. *macro-nodes and micro-infrastructure*).

This section will describe three types of nodes which have the potential to enhance the benefits of rural transport connectivity to higher level networks: rural freight and logistics centres; roadside stations and markets; and nodes of higher transport networks, such as international gateways, railway stations and border crossing points.

5.3.1 Rural Freight Centres

Researchers and organisations are now exploring the factors which contribute to the success or failure of agricultural value chains. Availability and quality of transport services, collection and storage facilities (particularly for cold storage), infrastructure, and other transport related factors are thought to play a critical role (ADB, 2017).

At the local level, small-scale farmers usually have limited options for selling their produce. They may bring it to the local market; sell at the farmgate to middlemen, who then transport the goods further afield; or transport the goods to wholesale markets in towns or cities themselves. The structure and nature of these operations vary from country to country, and even from product to product. In some cases, middlemen charge the farmers for transport, while in others the farmers transport products using their own vehicles.

While rural logistics systems are still under-developed in many countries, the spread of Information and Communication Technologies has been catalytic in spurring governments to act, as well as in encouraging cooperation between the public and private sectors. As noted above, China has been actively developing its rural logistics system, for example by encouraging the creation of “rural logistics zones” (Figure 8).

Some governments are also looking to boost agricultural exports by encouraging investment in logistics centres, including dry ports¹² and special economic zones. Most of the cargo handled by modern logistics platforms are manufactured products, but some logistics centres also handle agricultural goods, such as the Savannakhet Inland Port near the 2nd Thai-Lao Friendship Bridge across the Mekong River (GMS, 2017). The location of logistics centres and dry ports affect patterns of regional development because they influence investment decisions. For example, in Cambodia, where dry ports are licensed by the Customs Department, regulations require that they be located within 20 km of a border post or within the Phnom Penh urban area. This makes it difficult to establish dry ports in regional centres, such as Battambang, Siem Reap and Kampong Cham, which generate large export volumes. Governments may need to rethink the role of dry ports,

FIGURE 8. RURAL LOGISTICS DISTRIBUTION VEHICLE IN RUI AN, ZHEJIANG PROVINCE, CHINA



The Zigui County Logistics Bureau worked with the Huawei Logistics Company to invest in the construction of centralized logistics service points in more than 20 townships and towns. Photo source: Rural logistics distribution vehicle in Rui An, Zhejiang Province, China. Source: Lichun Hu, Rui An Department of Transportation, China, 2019.

¹² According to the Intergovernmental Agreement on Dry Ports, a *dry port of international importance* “refers to an inland location as a logistics centre connected to one or more modes of transport for the handling, storage and regulatory inspection of goods moving in international trade and the execution of applicable customs control and formalities” (*Article 1 of Inter-governmental Agreement on Dry Ports*). Dry ports 1) act as a node between the transport link from international gateway (usually maritime port) and the transport link from the dry port to final inland destination; and 2) provide border crossing formalities for traded cargo (such as customs) so as to allow the goods to be transferred smoothly at the international gateway (UNESCAP, 2015).

not only as a transit centre for international cargo but also as potential catalysts for rural development.

5.3.2 Roadside stations and markets

Many researchers have studied the overall impacts of macro-level networks on local economies (e.g. Sengupta et al., 2016). The African Development Bank now recognizes that “A road becomes the market space for rural populations to sell their goods and earn income, boosting intra-regional trade and reducing spatial inequalities not only between countries but also within national boundaries” (Partnership on Sustainable, Low Carbon Transport, 2016). However, there is limited research on the mechanisms through which these impacts occur, especially at the nodes serving as sites of exchange, such as local markets.

In this regard, one approach which may enhance the benefits of macro-level networks on the local economy are roadside stations, or *michi-no-eki* in Japanese (Box 10). It is already common for rural producers to set up informal stalls along the side of major roads to sell local agricultural goods and other rural products, but these stalls may create traffic safety risks if there is not enough space for cars to park safely along the road. In contrast, roadside stations are “...spaces for rest and exchange along highways ...[their] functions are linked to rural roads as well as highways, and they create connections between the highway network and local communities” (World Bank, n.d). Roadside stations have been piloted and promoted in other countries, including Bangladesh, China, Mozambique and Thailand (see JICA, 2007, for Mozambique). In Africa, the Northern Corridor, which connects Burundi, Rwanda, Uganda with Mombasa port in Kenya, features roadside stations that also house health care centres, hotels, banks, supermarkets, police stations and parks (United Nations, 2016).

Box 10. Multi-purpose Roadside Stations in Japan

As of July 2019, there were 1,160 roadside stations, or *Michi-no-eki*, all over Japan. The three main functions of the *michi-no-eki* are to provide 1) Rest facilities; 2) Opportunities for interaction with local areas and communities, and 3) Information about road conditions, tourist sites, and emergencies.

From the perspective of road authorities, roadside stations contribute to road safety by encouraging drivers to stop and rest, especially during long-distance journeys. To be recognized as an official roadside station, the facility must offer certain facilities, such as barrier-free toilets, free parking spaces, and public telephones. To attract people to stop, roadside stations also offer unique activities such as live performances of Japanese dances, hot spring facilities, restaurants, and other events, while some offer quick charging stations for Electric Vehicles (EV).



Yutori Park Tamagawa, a roadside station near Hagi city, Yamaguchi Prefecture, where there is a market selling fresh produce, fish, and local products such as jam, sweets, condiments, and pottery. Source: J. Yamamoto.

Where community associations and residents are involved in their operations and management, roadside stations can be seen as a model of community-driven development. However, they also face challenges, such as pressure to recoup the large capital investment and competition from other roadside stations (Miyamoto, 2005).

Sources:

- All Nippon Michi-no-Eki Network website, accessed 10 September 2019 (<https://www.michi-no-eki.jp/about/aboutus>).
- Miyamoto, T. (2005). The Role Of Strategic Marketing Management In A Japanese CommunityDriven Development Program, Michi-No-Eki (Road Station). ANZMAC (*Australian and New Zealand Marketing Academy conference*) 2005 Conference: Social, Not-for-Profit and Political Marketing.

5.3.3 Border crossings, ports and other major nodes on higher level networks

International gateways such as border crossings, maritime ports, and airports, as well as major railway stations, towns and cities where people enter and exit the networks, constitute major nodes in international networks. Policy discussions about border crossings, maritime ports, and airports often focus on their operational characteristics, and how these affect the efficiency of trade and mobility. For example, border crossing studies measure the time, costs and risks associated with border crossings, and how these can be improved to facilitate trade.

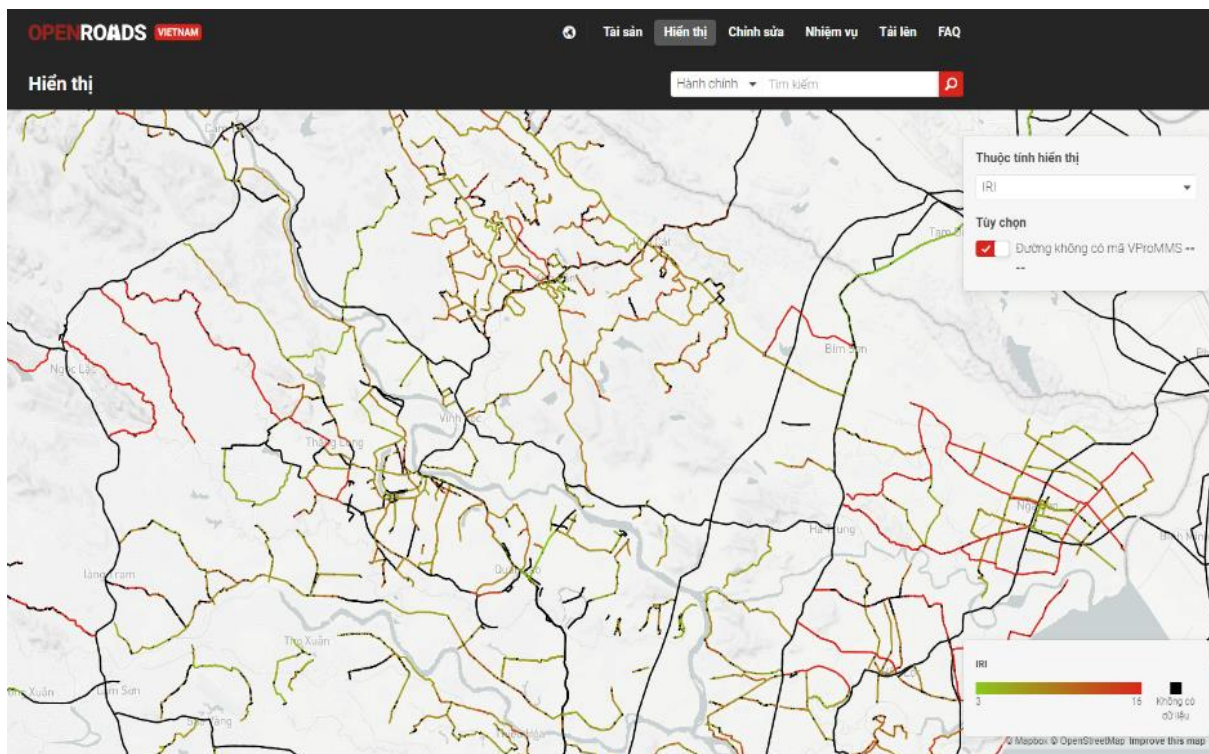
The literature on the impact of border crossings, maritime ports and airports on local economics suggest that they have both positive and negative effects. For example, access to border crossings have been found to be extremely important for informal traders, many of whom are women (see Kusakabe, 2014, for a collection of case studies on gender dimensions of rural transport).

A recent trend has been for governments to designate space for border markets, or border *haats*. Such markets can be found between India and Bangladesh, India and Nepal, as well as Thailand and Myanmar, and are a potentially important means to enhance the economic and social value of border crossings. Figure 9, for example, shows some stalls selling goods from Myanmar at the Talad Dan Sing Kohn border market in Prachuap Kiri Khan province, border of Thailand and Myanmar.

FIGURE 9. STALLS AT THE ENTRANCE OF TALAD DAN SING KHON BORDER MARKET, THAI-MYANMAR BORDER



Source: J. Yamamoto



Screenshot of Open Roads website showing section of Viet Nam’s road network. Source: Viet Nam Country presentation.

6 Measuring and monitoring rural transport connectivity

To design effective rural transport policies, governments need a large volume of data as well as the technical capacity to analyse this data. In theory, governments have transport sector data management systems (TSDMS) to monitor the various activities taking place in the transport sector and evaluate the results of the strategies and policies (Nogales, 2015), but country practices vary widely.

Furthermore, governments may not have any data for rural roads which have been built by local communities or even private sector companies. These roads may be quite important for connectivity but are usually not engineered or built according to design standards, and therefore carry a higher risk. As Sudmeier-Rieux et al. (2019) note, weak governance plays a significant role in explaining the poor state of mountainous roads in Nepal, many of which are “dozer roads” built without proper engineering design.

The absence of common definitions and classification systems make it difficult to compare rural transport data across countries. During the negotiations on the Sustainable Development Goals, this lack of a common indicator led to the adoption of the Rural Access Index (RAI) was adopted as an indicator for target 9.1., which is to “Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all”.

This chapter presents an update on the RAI, including its strengths and limitations. It describes the progress being made to gather the data needed to assess the RAI, such as by using

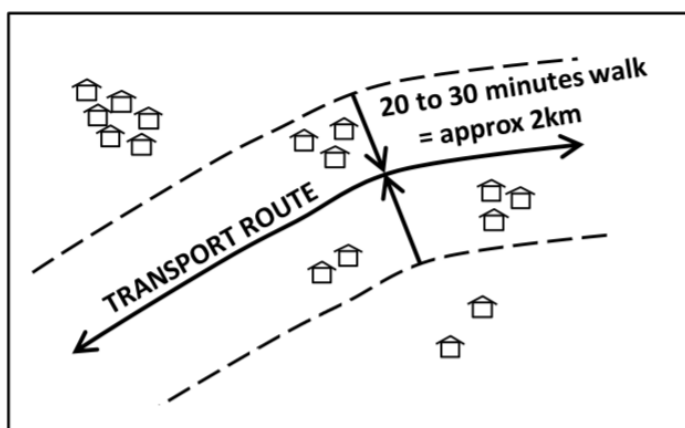
Geographic Information Systems (GIS), as well as some of the innovative ways in which spatial data is being collected.

6.1 Rural Access Index (RAI)

The Rural Access Index (RAI) was developed by staff at the World Bank in the mid-2000s because they felt that conventional measures of transport didn't fully capture the impacts of rural transport investment - in other words the extent to which households benefitted from improvements in access (Roberts et al., 2006). The RAI is measured as the “share of the rural population who live within 2 kilometers (typically equivalent to a walk of 20-25 minutes) of an all-season road as a proportion of the total rural population” (Figure 10). An all-season road is defined as “a road that is motorable all year by the prevailing means of rural transport (often a pick-up or a truck, which does not have four-wheel-drive). Predictable interruptions of short duration during inclement weather (e.g. heavy rainfall) are accepted, particularly on low volume roads” (Roberts et al., 2006). In 2006, the World Bank published RAI estimates for 64 countries globally, including 23 countries in the Asia and Pacific region.

FIGURE 10. MEASUREMENT OF THE RURAL ACCESS INDEX

Source: Vincent (2018)



However, the RAI is not widely monitored by governments, mainly because it is seen to be costly to collect the necessary data (the original approach relied on household survey data).¹³ It has also been criticised for several other reasons (see issues raised in Vincent's “Status Review of the Updated Rural Access Index”, 2018), including:

- If used as a criterion for funding, it can potentially lead to an overinvestment in rural roads at the expense of secondary roads, which may be as important for long term rural development (Faiz, 2012). Raballand, Macchi and Petracco (2010) also argued that efforts should go into designing efficient freight consolidation systems rather than providing road access to every farm, as this could lead to lower transport costs and ultimately increase demand for agricultural products (see Box 8 in Section 5).

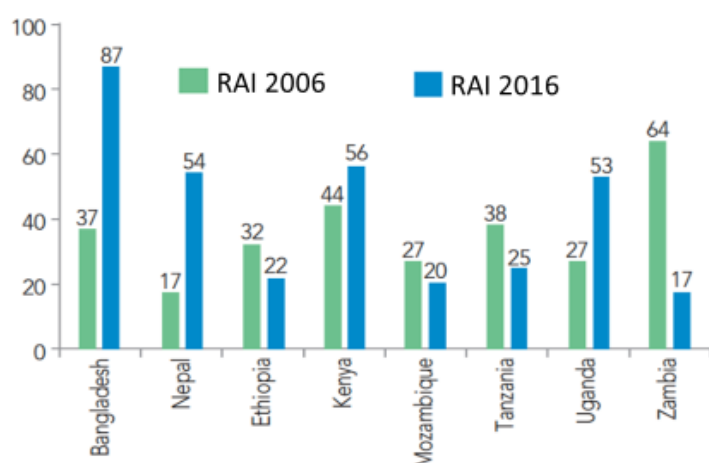
¹³ See Roberts, KC Shyam, & Rastogi (2006) for an explanation of the original RAI, and World Bank (2016) for details of the revised RAI.

- As the RAI is being proposed as a means to compare SDG “progress” across countries, it is usually presented as an aggregate (national) figure. This obscures subnational differences, which are important for planning.
- The use of a horizontal distance of 2 km, without taking into account the terrain, can lead to an overestimation or underestimation of actual access. The terrain will affect the real accessibility of a road (for example, the time taken to walk a mountainous 2 km and a flat 2 km will be significantly different) (Eqbali et al., 2017). Work is now in progress to reflect selected accessibility factors, such as terrain and climate.
- The RAI is a binary indicator with the population divided into those who have and those who don’t have access within 2 km. It doesn’t provide any information about how far the households are from the road; in other words, the extent of “inaccessibility”. To capture this information, some researchers in India have developed an alternative measure called the “Rural Inaccessibility Score” (see Box 11). However, this shortcoming is expected to be overcome with further research into the use of geospatial tools which can capture this information.
- The RAI doesn’t capture transport services.

In response to these criticisms, the UK Aid funded Research for Community Access Partnership (ReCAP) supported the World Bank in the development of the 2016 methodology and is continuing to work in partnership with the World Bank in 2019 to enhance the methodology with supplemental guidelines. Their goal is to eradicate inconsistencies in data collection, meet international standards, and provide a clear framework for data validation.

The 2016 methodology was pilot-tested in eight countries and a new set of RAI data was published (Figure 11). As can be seen, there was a substantial difference in the results, but this is also due to differences in the methodology as well as the time lag between the studies. This research has helped change the status of the RAI from Tier III to Tier II, which means that the “Indicator is conceptually clear, has an internationally established methodology and standards are

FIGURE 11. COMPARISON OF RAI USING TWO DIFFERENT APPROACHES (2006 AND 2016)

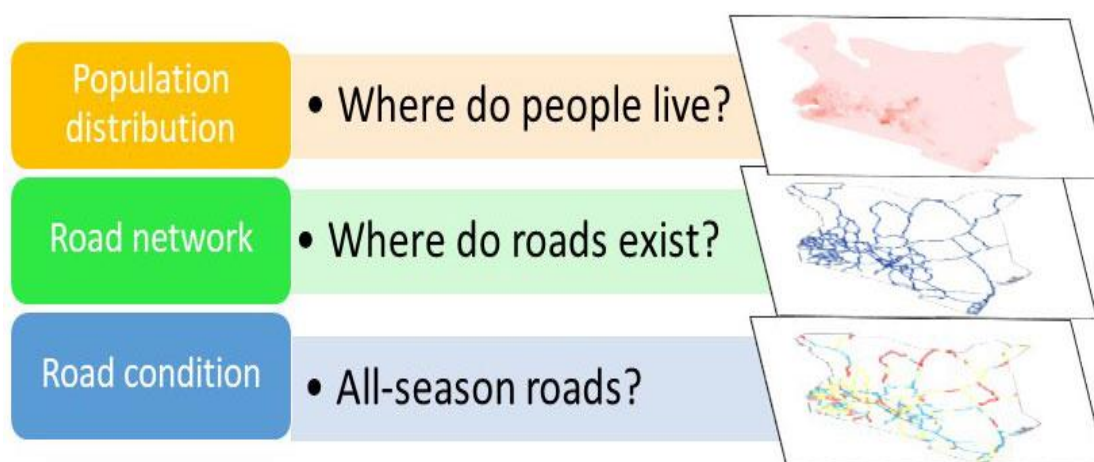


Source: Presentation by A. Bradbury at the EGM on “Enhancing Rural Transport Connectivity to Regional and International Transport Networks”, July 2019.

available, but data are not regularly produced by countries.”¹⁴

To encourage more governments to monitor the RAI, the challenges of data collection need to be overcome. Under ReCAP, the Transport Research Laboratory is working in partnership with the World Bank to refine existing and proposed methods for data collection and is testing a supplemental methodology in cooperation with the governments of Malawi, Ghana, Nepal and Myanmar. In particular, the emphasis is on how new technologies, including geospatial software, such as WorldPop and OpenStreetMap, can be used to measure where people live, where the road network is, and the condition of the road network. These layers are captured and stored in a GIS database (Figure 12).

FIGURE 12. GEOSPATIAL APPROACH TO ESTIMATING THE RAI



Source: Presentation by A. Bradbury at the EGM on “Enhancing Rural Transport Connectivity to Regional and International Transport Networks”, July 2019.

While the revised approach is still under review, some of the pros and cons are becoming apparent. In terms of the positive aspects of the new methodology, the use of spatial data, which can be sourced from satellite imagery and not collected from household surveys, is clearly cost effective. However, some data challenges remain:

- Using free sources such as WorldPop is preferable to buying data, but free data updates are not necessarily done on a regular basis. Eqbali et al. (2017) also noted that population models used by WorldPop depend on modelling algorithms. Such models may overestimate the RAI “because populations are – by design of the model – distributed along the road network.” But this may not be the case. ReCAP is trialling a tool to allow countries to upload ‘ground-truthed’ data into open source data, thereby making it more accurate.

¹⁴ To facilitate the implementation of the global indicator framework, all indicators are classified by the IAEG-SDGs into three tiers based on their level of methodological development and the availability of data at the global level. A Tier 1 Indicator is conceptually clear, has an internationally established methodology and standards are available, and data are regularly produced by countries for at least 50 per cent of countries and of the population in every region where the indicator is relevant. A Tier 2 Indicator is conceptually clear, has an internationally established methodology and standards are available, but data are not regularly produced by countries. For a Tier 3 Indicator, no internationally established methodology or standards are available but methodology/standards are being (or will be) developed or tested.

- Many countries do not measure rural road conditions, especially for unpaved roads. Even if road condition data is available, it may not necessarily indicate accurately the all-season status of a road or network of roads. The revised methodology being developed at present proposes to incorporate “accessibility factors” into RAI calculations to estimate the likelihood of a road being impassable, such as road surface, climate and terrain. For example, a paved road in a flat area with low rainfall would have an accessibility factor of 1.0, as this road is designed to be accessible all year round, but an unpaved road in a mountainous area with high rainfall would have a much lower accessibility factor of 0.95 or perhaps even 0.90. Being unpaved, it is naturally vulnerable to rainfall, and the terrain heightens the chances that it will become impassable.
- In reality, people living in rural areas are using transport modes which do not necessarily rely on motorable roads. In particular, the widespread use of motorcycles suggests that there is a need to capture access to paths and not just roads. Furthermore, the use of inland waterways is not reflected in the RAI, despite the fact that it is a vital mode for rural residents in many countries. Further research is needed to see if there is a need to develop alternative or secondary indicators for rural access.

Section 6.3 describes some innovative approaches to gathering data, which go some way toward overcoming the above limitations.

6.2 “Mapping” rural connectivity in Geographic Information Systems

The spread of geographic information systems (GIS) has helped increase the uptake of spatial information in public policy processes. The transport sector in particular has benefitted from the technological advancements in spatial mapping software. Within the rural transport sector, GIS databases commonly form the basis for rural road asset management systems. Such systems are already in use, for example, in Bangladesh, Timor-Leste, India, Nepal, Thailand, and Viet Nam, to name just a few.

GIS maps are also being applied to a wide range of analytical purposes, including measuring rural access as described above. In India, for example, the Geospatial Rural Road Information System (GRRIS) has a “quarry tool” which estimates the cost of carrying material from quarries to road construction sites. Some additional potential uses of GIS for monitoring indicators of rural transport connectivity are described below.

Box 11. Rural Inaccessibility Score (RIS): An Alternative Measure to the Rural Access Index

One of the weaknesses of the Rural Access Index (RAI) is that it conveys the proportion of the total rural population which are not within the 2 km buffer zone from the road, but not the actual distance of habitations from the zone. In other words, the relative “level of inaccessibility” (difference in distance) experienced by residents is not considered.

To illustrate, the figure below shows two hypothetical districts. The triangles represent habitations, while the grey lines are rural roads with a 2 km buffer on either side. The two districts have the same Rural Access Index in terms of proportion of population outside of the 2 km buffer zone around roads. However, habitations in (b) are actually further away from the roads, and therefore can be said to be at a greater disadvantage.

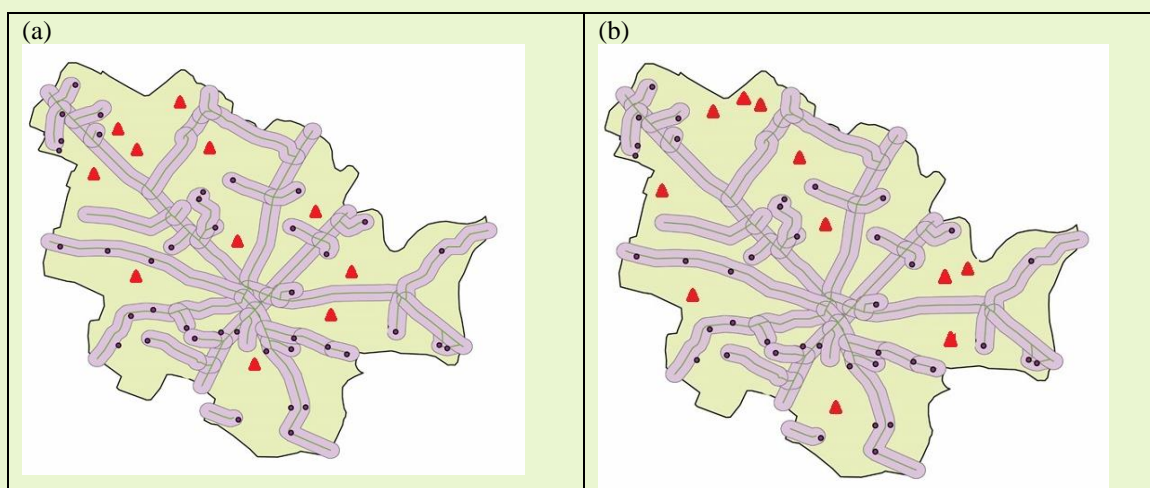
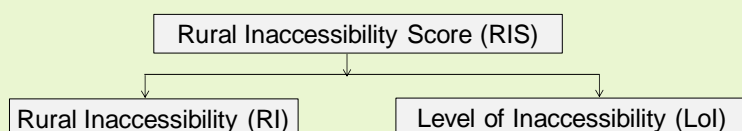


Figure: Habitations outside of the 2 km buffer from the road but (a) close to buffer border and (b) further away from the border.

To reflect the relative access of habitations, a different approach is proposed. This approach is called the Rural Inaccessibility Score (RIS) which is the combination of the measure of Rural Inaccessibility and a measure of Level of Inaccessibility.



Rural Inaccessibility (RI) is equivalent to the total population having no access to road in a region/country. The cut off point for access varies, with the World Bank using 2 km and the Government of India’s PMGSY using 0.5 km (and 1.5 km for hilly areas). The Level of Inaccessibility (LoI) can be calculated either without taking population into account (Equation 1) or taking population into account (Equation 2).

Equation 1:

$$LoI = \frac{\text{Length of hypothetical road network}}{\text{Number of unconnected villages}} + \sum_{i=1}^2 \frac{(Ri * \text{Length of road network unusable/partially usable due to poor road cond.})}{\text{Number of villages unconnected/partially connected due to poor road condition}}$$

R_i is the weightage assigned, based on the condition of the road network. If the condition of the road network is unusable, a weightage of 0 will be adopted, whereas if the condition is poor, weight of 0.5 can be adopted. If the condition is good, then R_i is 1.

In order to reflect the population, an additional variable is added. W is the inaccessible population within the region/block, and W_i is the population of villages unconnected/partially connected due to poor road conditions.

Equation 2:

$$LoI = \frac{W * (\text{Length of hypothetical road network})}{\text{Number of unconnected villages} + \sum_{i=1}^2 \frac{W_i * (R_i * \text{Length of road network unusable/partially usable due to poor road condition})}{\text{Number of villages unconnected/partially connected due to poor road condition}}}$$

The indicator measures the length of road network needed to reach all habitations. This figure forms part of the measure of inaccessibility.

The combination of the Rural Inaccessibility (proportion of population without access) and Level of Inaccessibility (length of network needed) allows policy-makers to emphasize different goals. For example, it can distribute its priorities between population having no access and the level of inaccessibility:

$$RIS = [w_1 (RI_{\text{scaled}}) + w_2 (LoI_{\text{scaled}})]$$

RI_{scaled} is the score given on a scale between 10-100, with the range of each scale depending on the maximum, minimum and range of RI values obtained in the study. Similarly, LoI calculated is scaled between 10 and 100 (LoI_{scaled}). w_1 and w_2 are the weights the policy-maker would like to put on Rural Inaccessibility (RI) and Level of Inaccessibility (LoI) respectively; the summation of w_1 and w_2 will be 1. Thus, if the policy-maker puts an equal emphasis on both aspects, then the equation would look like:

$$RIS = [0.5 \times (RI_{\text{scaled}}) + 0.5 \times (LoI_{\text{scaled}})]$$

The Blocks may be prioritized on the basis of RIS scores for rural road development: the higher the score, the higher the priority. In case the scores of two or more Blocks are the same, the decision to prioritize them may be left to the decision maker. If serving maximum population is the objective, priority will be given to the Block with the maximum RI scaled value; on the other hand, LoI_{scaled} needs to be given priority if connecting the most inaccessible habitations is the primary objective.

The suggested method is logical and offers another way of showing the accessibility level of a region. One advantage is that the policy makers have the option of deciding the weights of the parameters. Moreover, the condition of the roads can also be included while calculating the index, making decisions more practical.

Source:

A.K Sarkar and Puppala H, (2019) Rural Inaccessibility Score (RIS): A New Approach to Quantify and Prioritize Rural Areas, 98th Annual Meeting of Transportation Research Board, 14-17 January 2019, Washington, D.C.

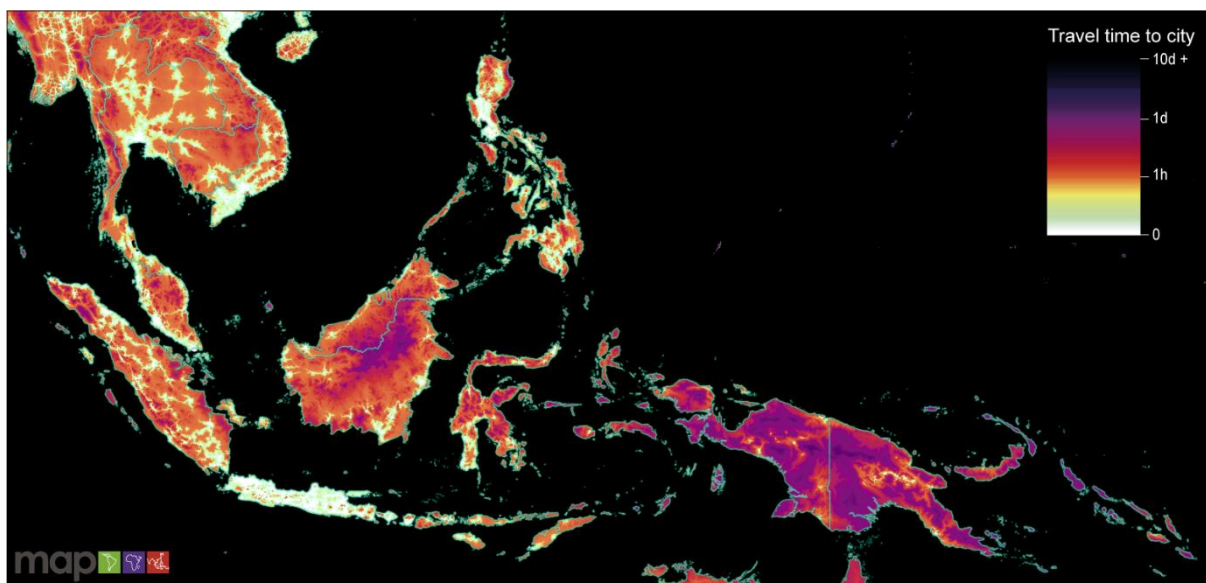
6.2.1 Time-based indicators

Travel time maps measure the time needed to travel from an origin to other areas using isochrones (lines of constant time) (Litman, 2011). By colouring the maps, one can visually see the travel times from a point. Thus, it becomes possible to compare, in a visual way, the differences in the travel times of different modes such as public transport and driving. Some examples of these maps are given on the website of Mapumental (<https://mapumental.com/>).

In the field of urban transport, GIS is becoming a standard tool for measuring time-based accessibility (see, for example, Transport for London, 2015). Time-based accessibility is critically important for planning ambulatory services or humanitarian response strategies but is still costly to roll out in some countries because it requires regularly updated or real-time data. On the other hand, researchers are now exploring ways to apply available data to estimate time-based accessibility on a large scale. For example, using available data from Open Street Map, Google roads data, and the Global Human Settlement Grid, a recent study mapped accessibility to cities for the whole world by estimating travel times from all sections of the country (Weiss et al., 2018). An image of South East Asia below, provided by the research team of this study, is shown in Figure 13 (the lighter the colour, the lower the travel time to cities).

FIGURE 13. MAP OF SOUTH EAST ASIA SHOWING TRAVEL TIME TO CITIES AS AN INDICATOR OF ACCESSIBILITY

Source: Malaria Atlas Project



6.2.2 Trace mapping and access to social facilities

Increasingly, household survey data and other sector specific surveys such as the UNICEF's Multiple Indicator Cluster Surveys and USAID's Demographic and Health Surveys (DHS) collect geo-referenced information about households. If this data were systematically linked to regional level transport data, such as roads, rivers and environmental conditions, then a much

richer spatial analysis could be performed.¹⁵ The PMGSY programme of India is using “trace-mapping” to identify and trace the closest schools, hospitals and markets to habitations and use this to calculate the number of habitations which depend on each road (Figure 14). The information provides the government with information about the size of the population which would be affected (for example, cut off from education) if the road deteriorates (India Country presentation).

FIGURE 14. TRACE-MAPPING OF KUSUMI, ODISHA, INDIA



Source: India Country Presentation

6.2.3 Transport costs

Given that one of the main objectives of improving rural transport is to bring down transport costs, such costs have traditionally been used to evaluate rural transport projects. Such costs can also serve as an important indicator of connectivity. A report for the ADB noted that “the lower the cost to rural people - in terms of the monetary cost, physical effort involved and time spent – of travelling and moving their goods to and from the physical facilities, services, resources and opportunities that they need to use, the higher the level of access that they have.” (ADB, 2007, p.5). As discussed earlier, many factors influence transport costs, but it may be possible to map information about costs such as average costs of transport (for example, per km) or the cost per kilogram per kilometer of the product (Chamberlin et al., 2013). Some researchers have combined different sources to produce cost data: Casaburi et al., for example, used data on transport fares and GIS video stream data collected on the roads of Sierra Leone (Casaburi et al., 2012).

¹⁵ DHS surveys are currently conducted in over 25 countries of the Asia Pacific region. See the country list on the DHS website: <https://dhsprogram.com/Where-We-Work/#activeType=all&printStyle=false&mLon=12.8&mLat=11.7&mLev=2&title=Where%20We%20Work&desc=>

6.3 Innovative approaches for collecting rural transport data

The rapid evolution of information technologies and digital sources of data has greatly expanded the scope for collecting rural transport data. Many governments and research institutes are currently experimenting with these new tools. Box 12 describes how the Government of Timor-Leste and the ILO used a combination of methods to draw up a Rural Roads Master Plan and Investment Strategy (RRMPIS).

The Transport Research Laboratory (TRL) in the U.K. recently investigated the use of “high-tech” solutions for collecting data on remote and rural transport systems (namely roads), such as drones, video cameras, smartphone applications, accelerometers, GIS, crowdsourcing and other satellite applications (Workman, TRL, 2018). Trials were conducted in Ghana, Kenya, Tanzania, Uganda, Zambia to assess road inventory and conditions from Very High Resolution (VHR) satellite imagery. As part of this project, a useful guideline on the above technologies was published (see Annex II of ReCAP, 2017, for a list of different types of technologies). Drawing on ReCAP research (2017), some of the main types of technologies are introduced below.

6.3.1 Remote sensing and automatic mapping

The World Bank and other researchers are now using more and more satellite imagery to gather data for the Rural Access Index (World Bank, 2016). The software for interpreting remote sensing imagery and using it to assess road attributes (such as condition of road) have progressed rapidly. However, according to ReCAP (2017) a certain level of manual intervention is still required, particularly to check that the automatic mapping is correct. As they improve, these technologies will help governments monitor changes in their transport system, as well as with socio-economic development.

6.3.2 Automatic road roughness data collectors

Today there are several different systems for collecting data automatically when driving. They include the bump integrator, MERLIN, roughometer, 5th wheel bump integrator, profile beam, walking profiler, inertial measurement unit, and laser profilers (ReCAP, 2017). Some applications for smartphones have also been developed, which are currently being tested for accuracy but are expected to reduce costs in future (see RoadLab: <https://www.roadlab.org/> and Roadroid: <http://roadroid.com/>). The Central Road Research Institute of India has developed its own “automatic road unevenness recorder/bump integrator” and “vehicle mounted bump integrator with GPS” (CRRI website accessed May 12, 2019).

6.3.3 Global Navigation Satellite Systems, GPS and probe data, “Big Data” and real time monitoring

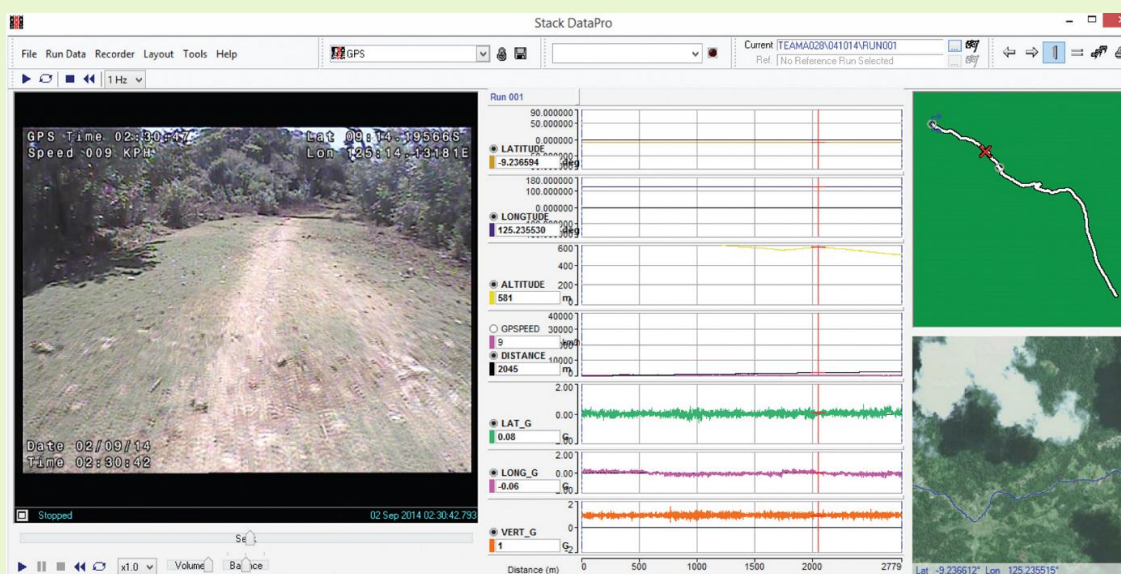
Increasingly, people are recording their own movements. For freight transport, data garnered from tachographs, which are a legal requirement on commercial trucks in Europe, has been analysed to study transport and logistics movements. With the spread of mobile smartphones, the number of people carrying around GPS devices has increased at an exponential rate. Within the transport research community, there are many studies which test the accuracy of GPS for collecting traffic information as well as personal trip data. Call Detail Records (CDR) also provide information about location and time, whenever the phone user sends or receives a short messaging service (SMS) or call.

Box 12. Development of East Timor's Rural Roads Master Plan and Investment Strategy

In 2014, there was no digitized road data or maps in East Timor. So the Government and the ILO began by collecting secondary data from the National Directorate of Roads, Bridges and Flood Control (BRBFC) under the Ministry of Public Works, Transport and Communications and other ministries, including location information for major facilities (bridges, hospitals, land-use). The data was reviewed and converted to GIS, and then validated through consultation workshops.

As part of this exercise, the project team also drew up a preliminary system for classifying roads. This led to a preliminary list of rural roads totaling 3,855 km, which were then surveyed to check for their road condition. As the table below shows, various data collection methods were used for the survey. A screenshot from the Digital Video Recording Equipment is also shown below. By using a wide variety of data, the team was able to develop the Rural Roads Master Plan and Investment Strategy in a relatively short time.

	Features/Attributes	Data Collection Methods and Instruments
1	Location of road and structure, terrain type, maximum gradient of sidelong slopes	<ul style="list-style-type: none"> • Continuous video recording and photos at spot locations • Inspections, using survey forms; every 200 metres for alignment and point locations for ancillary structures • GPS every 200 meters for alignment, point locations for structures
2	Road condition	<ul style="list-style-type: none"> • Continuous video recording and photos at spot locations • Inspections, using survey forms; every 200 metres for alignment and point locations for ancillary structures • GPS every 200 meters for alignment, point locations for structures • Travel speed
3	Landmarks and social facilities	<ul style="list-style-type: none"> • GPS point location, photos and spot inspections • Interviews with local residents every 5 km
4	Details of gravel pits, quarries and relevant local industries	<ul style="list-style-type: none"> • GPS point location, photos and spot inspections • Interviews with local residents every 5 km • Survey forms
5	Traffic and priority interventions	<ul style="list-style-type: none"> • Moving observer counts during drive on (windscreen traffic counts) • Interviews with local residents every 5 km • Engineering assessment every 5 km of required priority interventions



Source: Egbali, S.F., Athmer, B. and Asare, A. (2017). Rural Access Index (RAI) – the Case of Timor-Leste.

A growing body of research is experimenting with the use of Big Data. For example, the ieConnect programme at the World Bank is developing data systems using new technologies to “harvest” large amounts of data with greater coverage and resolution than traditional survey methods allow. A pilot project under this programme seeks to map car crashes in Kenya using remote sensing, crowd-sourced information on crashes, drones to track pedestrian movements, and “web-scraped” congestion patterns from GPS trackers (World Bank, 2018, p.76). Meanwhile, Miyazaki (2019) and Keola (2019) use satellite-based probe data to look at commercial vehicle movements in Thailand and neighbouring countries. These studies can yield interesting insights about the connectivity of places based on frequency of trips, as well as based on time and distance-related trip data (Box 13).

6.3.4 Internet based maps

There are several technological platforms which use the internet to share data and spatial information. One of the best known is OpenStreetMap which allows users to edit maps and upload map data using their smartphones. Another system which was developed in the Philippines is called Openroads (<http://www.openroads.gov.ph/>). This platform uses satellite imagery, UAVs and any open source materials, while volunteers can also upload their geo-tagged photos, thereby facilitating real-time updating (for example, if there is a natural disaster or problem with roads).

6.3.5 Unmanned Aerial Vehicles (Drones)

Technologies to develop UAVs, or “drones”, are also moving ahead at a rapid rate. There are several types of UAVs, each with slightly different technological specifications which allow them to fly in different ways, but also for different lengths of time. Some are more suitable for collecting data than others. According to ReCAP (2017), the cost of using drones may be still more expensive than satellite imagery.

6.3.6 Artificial Intelligence (AI)

The status of AI applications in the transport sector is continuously changing as more and more research is conducted. In India, the Government is experimenting with the use of AI for predictive modelling for prioritizing roads for maintenance, with pilot tests in Madhya Pradesh and Tamil Nadu (India Country presentation). AI holds particular promise in helping to predict the likely deterioration of roads and prioritise investments accordingly, based on historical and real-time data on road conditions and age, rainfall records, temperature, soil type and traffic density. It can also help identify cost outliers in the screening stage of the district planning process.

6.4 Key observations

More research is needed on the cost-effectiveness, accuracy and appropriateness of using these new technologies, particularly how they can best match the needs of the government agencies. Into the future, it is highly likely that these technologies will be used in combination with each other, with the different data systems forming a kind of “ecosystem” of data. To assess connectivity in a functional sense, more data is needed about the actual processes through



Bringing milk to market in Assam, India, 2010. Source: Michael Foley

7 Conclusions: Next steps towards rural transport connectivity

Rural transport connectivity is clearly an important transport sector goal for governments in Asia and the Pacific. More investment in rural transport infrastructure can help improve connectivity, but it needs to be targeted to link different network levels together. Meanwhile, investments in rural transport services and nodes are also needed to improve the efficiency of rural transport systems. To achieve the best outcomes, the cooperation of policymakers at all levels is needed.

As general measures to improve rural transport connectivity have been discussed extensively in other publications and documents, this section will highlight those areas for action which would specifically enhance rural transport connectivity to higher level networks. The study recommends interventions in six different areas. Increased investments in rural transport connectivity as well as increased efforts to monitor the progress in a systematic way would be needed. Strengthening of rural road asset management, inter-departmental coordination and research on rural transport are needed. Improving coordination between international organizations, government and other stakeholders are also needed towards developing sustainable rural transport connectivity in the member countries.

Increase investment in rural transport connectivity, including rural transport services and transport nodes

As noted in Section 4, large-scale infrastructure projects can have severe consequences for the communities living along them. In addition to displacement, such consequences may include higher risk of traffic accidents; deterioration of water sources due to run-off from roads; noise and air pollution; and physical separation, for example when roads cut off access between

habitations and workplaces. Some studies have noted that without proper planning, there is a risk that some local communities will try to access Belt and Road Initiative trunk roads using poorly engineered local roads (Sumeier-Rieux et al., 2019).

On the other hand, the development of new roads may also offer new opportunities. These opportunities can be realized if rural roads and paths are integrated in such a way as to allow easier access to major roads, transport nodes and services. To manage both positive and negative impacts, more attention to rural connectivity is needed in the project design phase.

Strengthen rural road asset management

Rural transport infrastructure, whether it be rural roads, inland water transport or sea shipping infrastructure, have significant asset value. In order to benefit from these assets over time, these infrastructure systems need to be preserved. Burrow et al. (2016) note that while road asset management for strategic roads have improved, less progress has been made for rural roads. They attribute this to reasons such as political factors, insufficient maintenance budgets, the lack of a means of motivating policymakers to fund maintenance, and ineffective rural road asset management.

The first step towards better management of rural roads is the establishment of a robust rural road asset management framework. Several best practice standards are already available, such as the ISO 55000 series on Asset Management and PIARC's Asset Management Manual (see ISO and PIARC websites for more information). Almost all governments have an inventory of their rural roads, but the robustness and reliability of these inventories is not known. In this regard, it may be useful to conduct a review of the status of rural road asset management systems in Asia, using for example the methodology developed by Burrow et al. (2016) to assess the "maturity" of road asset management systems in Africa. Such a study would provide a clearer picture about how rural road asset management systems are linked to other transport network levels.

Meanwhile, initiatives to strengthen rural road asset management systems can help build public sector capacity in GIS and other data management systems. The use of the Rural Access Index as an asset management and monitoring tool for the rural road sector, as was done by the Government of Timor-Leste with support from the ILO, could be further explored (Box 12).

Increase efforts to monitor rural transport connectivity, including the use of the Rural Access Index

At present, the Rural Access Index is the best available indicator to compare access to rural roads across countries. It has also been adopted as an indicator under Goal 9 of the Sustainable Development Goals. In this regard, governments should look at ways to strengthen their capacity to accurately record the RAI of their countries. More opportunities are also needed to discuss how the RAI can be usefully employed by governments and donor agencies in their planning processes. For example, experiences from projects funded by the African Development Bank showed that the RAI may be a useful measure to evaluate the impact of individual rural transport projects (Vincent, 2018).

Furthermore, governments should look beyond infrastructure access and see how to incorporate rural transport services and nodes in their planning processes. Given the tremendous growth of two-wheelers and new ride-hailing services, policymakers need to consider their impact on rural mobilities. In this regard, an interesting area to watch will be how the expansion of ICTs into rural areas affects rural mobility patterns. Increased digital access could create new opportunities for data collection: government officials and even members of the public will be able to collect trip and infrastructure data in a timely manner. Transport and ICT researchers may be interested in looking at whether there is a common way to “capture” the operationalization of connectivity, and if so how such a measure can be usefully employed by policy-makers to plan transport, ICT and land-use strategies.

Strengthen inter-departmental coordination

At the heart of rural transport connectivity to higher level networks is the need to strengthen coordination between the various government agencies. As discussed in Section 4, some governments have established clear methodologies for rural infrastructure planning, which incorporate connectivity between road network levels. However, there is relatively little empirical research on whether these systems are effective, and also how such coordination takes place in the absence of clear methodologies.

The use of GIS and other IT platforms may go some way in helping different government offices to share information, but first there needs to be a clear institutional framework to facilitate the sharing of information. The PMGSY program of India, for example, links all of its databases under an umbrella “Online Management, Monitoring and Accounting System” (OMMAS).¹⁶ Not all countries need such a complex system, but it could serve as a useful case study for other countries.

Improve coordination between international organizations, governments and other stakeholders

In the past, international organisations involved in rural transport have cooperated with each other by sharing of information and experts. Initiatives such as the joint ReCAP and SLoCAT project “Promotion of Sustainable Rural Access in the implementation of the 2030 Global Agenda on Sustainable Development” have been important for establishing a common voice at international fora, such as in negotiations on the Sustainable Development Goals.

It is now time to find more allies who will bring fresh perspectives into the sector. For example, UN HABITAT has proposed establishing a “Global Partnership on Promoting Urban-Rural Linkages” which would “support and build on existing efforts at global, regional, and national levels and build on past and current work to develop very focused and practical tools to achieve balanced and integrated development between urban and rural areas” (UNHABITAT, 2017).

¹⁶ See <http://omms.nic.in/>

Another important forum is the Sustainable Mobility for All initiative (SuM4All) launched in 2017, which represents many transport-related organisations and private sector associations.¹⁷ SuM4All identified “Universal access” as one of its four major focus areas, and states that it aims “to connect all people and communities to economic and social opportunities, taking into account the needs of different groups, including the poor, those in vulnerable situations, women, children, the elderly, and persons with disabilities, across geographical locations” (SuM4All website). It has since published the *Global Mobility Report 2017*, and the *Global Roadmap of Action toward Sustainable Mobility* (SuM4All 2017, 2019). More outreach activities, for example targeting academics and civil society organisations, could broaden support for the universal access goal of the SuM4All initiative. Greater cooperation is also needed with environmental experts, particularly on climate change adaptation strategies for rural infrastructure, and experts from the agriculture, tourism and disaster risk reduction fields.

Strengthen research on rural transport

Over the years, research conducted under the World Bank’s Sub - Saharan Africa Transport Program (SSATP), the ILO’s Integrated Rural Accessibility Planning (IRAP), the International Forum for Rural Transport and Development (IFRTD), Practical Action, and more recently the Research for Community Access Partnership (ReCAP) and Partnership on Sustainable, Low Carbon Transport (SLOCAT) have contributed to the global body of knowledge on rural transport. The Rural Access Library on ReCAP’s website is a useful repository of research on rural transport (see <http://research4cap.org/SitePages/Rural%20access%20library.aspx>).

However, if the international development community is serious about achieving the Sustainable Development Goals, then more resources need to be directed into rural transport connectivity, particularly rural mobilities and the links to the SDGs. International forums such as the Transport Research Board and the United Nations Global Sustainable Transport Conference should draw attention to the need for more research on rural transport issues in developing countries. Such issues include gender dimensions of rural transport, particularly for long-distance travel; transport-based social exclusion; road safety in rural and peri-urban areas; methodologies for integrating climate change adaptation into rural transport planning as well as into construction techniques; and intermodal connectivity between non-motorized transport, inland water transport, local railroads, and road transport, to name just a few.

Such research is most effective in informing policy if it draws on the actual needs and preferences of rural residents. In this regard, researchers may assist government policy-makers in soliciting the views of other stakeholders – community leaders, non-governmental organisations, business sector representatives, transport service providers, and so on – on what kind of measures would help remove obstacles to rural transport connectivity and enhance mobilities for their daily tasks and activities.

¹⁷ The Sustainable Mobility 4 All (SuM4All) initiative was formerly launched in 2017. It is a consortium of over 50 major transport-related organisations, agencies and private sector associations. More information is available at <https://sum4all.org/who-we-are>

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