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Chapter 4

RURAL ACCESS AND THE SUSTAINABLE DEVELOPMENT GOALS

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ABSTRACT

The Sustainable Development Goals SDG shall be the guiding principle for future cooperation with the developing world, replacing the Millennium Development Goals. This paper argues that the improvement of rural access in Developing Countries is essential for the success of the SDGs.

The author claims that the sustainability of a nationwide growth process is endangered if rural areas were not developed. Since bad access is one of the major causes of rural poverty and hampers rural development, rural access improvements are essential for the success of the SDGs. This issue is demonstrated by quoting a large number of studies that show the impacts of rural road improvements on 9 out of the 17 SDGs.

SDG 9 "Industry Innovation and Infrastructure" is the goal that directly provides guidance for access improvements. However, its operationalisation is related to a number of difficulties and challenges that need to be solved when implementing SDG 9.

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1. Introduction

The Sustainable Development Goals SDG shall be the guiding principle for future cooperation with the developing world, replacing the Millennium Development Goals. This chapter argues that the improvement of rural access in Developing Countries is essential for the success of the SDGs.

Poverty is predominantly rural and globally, one billion people are disconnected from the rest of the world[1]. The next section shows briefly how strong national growth processes are dependent on a successful rural development. The third section demonstrates that access improvements are essential to stimulate a rural development process. The fourth section shows how rural road improvements impact on 9 of the 17 SDGs. For this purpose, a large volume of scientific publications on rural road impact assessments is quoted.

2. Why Rural Development Is Crucial

Even though worldwide nearly half of the population is living in rural areas (UN DESA 2011), presently the focus of the development community is on the fast growing urban areas. This focus not only entails negative effects such as growing regional disparities and social injustice, but it neglects as well that an accompanying rural development is needed in order to achieve sustainable national growth. Basically, three arguments support this thesis:

Firstly, rural development is a catalyst for national economic growth. During the initial development process, rural areas have been an important source of demand for nationally produced goods and services. This again stimulated the growth of national industries that made unprecedented growth rates for example in China (Chua Beng Huat 2015) and Ethiopia (Møller et al. 2015) possible. In Sub-Sahara Africa where more than 60% of the

[1] Rural Access Index: population having accessibility to the nearest all-weather road in terms of 30 minutes walking time. Source: Roberts (2005).

population lives in rural areas[2], even a low per capita increase in demand may generate considerable stimulus for national industries producing for inland markets due to the large number of consumers in rural areas. In China, the development of rural agro-industries reinforced this process, which would not have taken place without rural transport.

Secondly, the growing urban areas have an increasing demand for high quality food products. If rural farmers are not improving efficiency and quality of their production, these demands will be satisfied by imported food items. Even if food security and self-reliance should not be politically opportune arguments, the saving of desperately needed foreign currency definitely is one.

Thirdly, increasing rural-urban disparities are neither sustainable nor desired. These disparities affect all spheres of life: income, education, health, opportunities, etc. Even without emphasising the ethical rational against disparities, negative social effects, such as rural out-migration and criminality are negative consequences of inequalities.

Urban areas may be considered as innovative growth centres that drive the economic development of the whole nation. However, rural areas must support this process in order to achieve sustainable development.

3. Why Rural Access Is Indispensable

One of the major obstacles against rural development is isolation: Globally, one billion people live more than two kilometres (25-30 minutes walking) from an all-season road, which refers to 31% of the rural population[3]. This Rural Access Indicator RAI shows as well a strong correlation between poor access and poverty (Global Mobility Report 2017). The lack of all-season roads is especially problematic in countries with rainy seasons when low volume roads often become impassable by tractors,

[2] http://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=ZF&year_high_desc=false.

[3] https://datacatalog.worldbank.org/dataset/rural-access-index-rai, An "all-season road" is a road that is motorable all year round by the prevailing means of rural transport (typically a pick-up or a truck which does not have four-wheel-drive) (Roberts 2005).

motorbikes or even non-motorized traffic. This difficulty locks people into subsistence farming as markets become regularly inaccessible. The poor quality of low volume rural roads also results in significant damage to produce en-route to markets and so reduces its value and the income to the farmer.

In the last 20 years a considerable number of studies[4] have been undertaken in order to assess the impacts of rural access improvements. Recent literature reviews were conducted by Sieber et al. (2016) and Starkey et al. (2014) on the impacts of rural transport improvements. The reviews were using all published documents during the past 20 years. Despite observed impacts being dependent on the local economic and geographic conditions, there is a consensus amongst the researchers about the positive effects of rural roads on income and poverty partly due to increased accessibility to social services and employment. Generally, there were two major impacts observed:

- Many studies confirmed that rural roads induce a market led local development, via agricultural marketing and increased incomes from farming.
- The studies revealed that rural roads increased the revenues from non-farming activities. This implies a shift from subsistence agriculture to commercial agriculture or manufacturing.
- However, roads are not sufficient to generate these effects on their own. The ability of the poor and very poor to benefit largely depends on their asset base and access to resources and opportunities.

An overview of all impacts observed in the literature survey by Sieber and Allen (2016) is presented in Annex 1. This survey is the basis for the following analysis. Examples of impacts observed in Cambodia are given in Box 1.

[4] Bangladesh: Khandker (2006) Kandler/Bär (2004), Brazil: Atsushi (2015), Cambodia: KfW (2013), Cameroon: Raballand (2009), China, Yunnan: Qiaolun Ye (2006), Indonesia: Gertler et al. (2014), Papua New Guinea: Gibson et al. (2002), Peru: Escobal (2003), Vietnam: (Mu Ren 2008, Van de Walle (2002) : India: Asher 2015, Banerjee 2015,: Chongvilaivan 2016, Philippines: Balisacan et al. 2002,

Box 1. Impacts of the Rural Infrastructure Program II in Cambodia

- The German Financial Cooperation with Cambodia (KfW 2013) conducted a major impact assessment study about their Rural Infrastructure Program (RIP) II and observed a number of positive effects.
- An average increase of 197% on annual household income among respondents across nine influence areas.
- A reduction of about 37% on total annual household transport cost.
- A reduction of about 15% on the average "unit transport cost"
- A reduction of 56% on average transport time.
- An increase of 86% on average daily traffic along the programme roads with 139% increase for motorized vehicles.
- A remarkable increase of 26% on the lower secondary school attendance, as well as an increase of 16% on the upper secondary school attendance.
- More people are availing the health services from the health centres, the record showed an increase of 36% in total average.
- Agricultural production has the following increases, rice (11%), grains (4%), cassava (146%), fruits (16%) and vegetables (23%)
- Almost three quarters (74%) of the respondents in the household survey perceived that the good roads have helped in the marketing of their products and in the improved flow of goods into the villages.

Source: KfW 2013.

The following section provides information on how rural transport contributes to the Sustainable Development Goals.

4. Impact of Improved Access on the Sustainable Development Goals

This section shows how improved rural access contributes to each SDG.

4.1. SDG 1: No Poverty

Poverty is predominantly rural! About 70% of the 1.4 billion people worldwide affected by extreme poverty live in rural regions. Additionally, it is the poorest households that rely mostly on farming and agricultural labour[5]. Missing or bad rural access means isolation that forces the farmers into a subsistence economy where they are not able to produce for markets, and thus have little monetary income. Access to markets is an essential pre-condition to generate rural income and thus reduce poverty.

Figure 1. End poverty in all its forms everywhere.

There is strong evidence that poor people benefit from rural road improvements. A large study (Fan et al. 1999) carried out by the International Food Policy Research Institute on linkages between government expenditure and poverty in rural India revealed that an a single investment of 1000 US$ in rural roads India lifted 7 people out of poverty. A similar research (Fan 2000) revealed that with the same investment in China 9 people are lifted out of poverty, which equals only 111 $ per person[6].

Khandker et al. (2006) researched rural road investments in Bangladesh, which "reduce poverty significantly through higher agricultural production, higher wages, lower input and transportation costs, and higher output prices .... We find a poverty reduction (moderate and extreme) due to road

[5] IFAD (2011): Rural Poverty Report 2011, https://www.ifad.org/asset?id=2095536.
[6] 1999 exchange rate.

improvements of about … 5-7%." Road investments are pro-poor, meaning the gains are proportionately higher for the poor than for the non-poor.

A number of other studies corroborate these findings:

- Kwon (2000) found in Indonesia that the poverty impact of growth was almost four times higher in provinces with high levels of road provision compared with those with poor levels of provision.
- Balisacan et al. (2002) found similar results for the Philippines, but also found that the impact is increased if coupled with education investment.
- Glewwe et al. (2002) found the poor households living in rural communes with paved roads in Viet Nam had 67% higher probability of escaping poverty than those in communes without paved roads.
- The development of all-weather rural roads in the Lao PDR, a country with extremely difficult upland topography and many villages without access to such a road, appears to lower the rural poverty incidence by 7% points (Warr, 2006).
- Dercon (2007) confirms the above findings through research in Ethiopia, which revealed that "access to all-weather roads increases consumption growth by 16% and, reduces the incidence of poverty by 6.7%."
- These findings are confirmed by Gibson (2002) in Papua New Guinea supporting the notion that poor areas have the least access to infrastructure and so people in those areas may benefit the most from new investments. Thus, infrastructure spending, whether on new assets or maintenance of existing facilities, can provide a form of targeted interventions that favours the poor.

Van de Walle et al. (2002) differentiates the impacts on the poor in her survey for Viet Nam: "The most interesting finding at the household level is that impacts significantly vary across income groups, and that the strongest impacts were for the poorest." Duncan (2007) contradicts van de Walle regarding the effects on the poorest. "Project experience from several

countries suggests clearly that households that do not report benefits from transport improvements fit the socioeconomic profile of chronic poor, typically suffering from disabilities, chronic disease, low education levels, and high dependency ratios. Nonetheless, short-term transport benefits may materialize for such households in the form of improved access to education, health care, and social services, which may then pave the way for better income opportunities in the future."

These findings are confirmed by Hettige (2006) who concluded while communities and the poor benefitted, there was little evidence that the 'very poor' benefited from the roads. This skepticism stems from the fact that the poorest sectors of society may not be able to benefit from improved transport and thus they may actually be left out and further disadvantaged by the externalities related to that growth.

Starkey and Hine (2014), in their comprehensive literature review, provide a good explanation for this: "Good transport infrastructure is a necessary condition for economic growth and poverty alleviation, but transport investments alone cannot address the problems of the poorest households." Thus road access is a condition sine qua non, but not sufficient without additional measures.

> 要想致富先修路
> To end poverty, build a road
> Chinese saying

4.2. SDG 2: Zero Hunger

Agriculture is the single largest employer in the world, providing livelihoods for 40% of today's global population. It is the largest source of income and jobs for poor rural households. Since globally, one in nine people are undernourished, the SDG target 2.3 intends to double the

agricultural productivity and incomes of small scale farmers that produce 80% of the food in the developing world[7].

Figure 2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

With three quarters of the world's hungry poor living in rural areas, cutting global hunger still means cutting rural hunger, as well as equipping smallholder farmers with the resources to play their roles in feeding the urban poor and hungry (IFAD 2016 p.25). Starkey and Hine (2014) conducted a large scale literature review on rural transport impacts assessing 360 documents. They resume their findings as follows: "Most rural communities depend on agriculture (including crops, livestock, fisheries and forestry) for subsistence and income generation. There are numerous research studies and several wide-ranging reviews that demonstrate how improving rural access has led to increased agricultural production, lower costs for farm inputs and lower transport costs for marketed outputs. Better road access leads to price changes in inputs and outputs and may affect cropping patterns, land prices and land ownership."

Good rural transport is an essential precondition to achieving this target. Rural roads are particularly critical to agriculture. During the whole year, farmers must be able to transport their products to the markets and purchase

[7] http://www.un.org/sustainabledevelopment/hunger/.

inputs to increase their productivity. The impacts of rural access improvements on agricultural production can be subsumed as follows[8]:

Figure 3. Impacts of rural access improvements on agricultural production.

Public investments in rural roads provide some of the best returns in terms of reducing poverty and promoting agricultural and non-agricultural growth. Sieber (2011) gives a broad overview of rural freight transport in Developing Countries with a strong emphasis on the importance of modern value chains for agricultural development. In Kenya modern agricultural value chains operating on rural roads had tremendous impacts on the development of Mount Kenya region (KENDAT 2013).

[8] Afghanistan (USAID 2006), Bangladesh (Khandker et al. 2006), China (Fan 2005), Democratic Republic of Congo (Ferf 2014), Ethiopia (Dercon et al, 2009), India (Aggarwal 2014, Bell and van Dillen 2012,Mohapatra et al. 2007, Raychudhuri, 2004, Fan et al. 1999), Indonesia Gertler et al. (2014), Nicaragua (Orbicon and Goss Gilroy, 2010), Peru (Escobal 2003), Uganda (ADB 2013), Viet Nam (Van de Walle 2002, 2007 Mu Ren 2008).

Box 2. Rural road improvements in Eastern and Central Uganda with a focus on socio-economic benefits

A major rural roads project in Eastern and Central Uganda to rehabilitate roads, build markets and introduce agro-processing equipment. … The project area has seen the proportion of marketed agricultural produce increase by 7.5%, farm gate prices up by 36%, post-harvest losses reduced by approximately 20% and a 40% rise in household income. Meanwhile, travel costs have dropped by 63%. Other benefits include the emergence of rural growth centres and more permanent housing; new schools and health facilities; higher school enrolment; better health, inter alia, because of more numerous antenatal visits to health centres especially for expectant mothers.

Source: African Development Bank 2013.

4.3. SDG 3: Good Health and Well-Being

Figure 4. Ensure healthy lives and promote well-being for all at all ages.

The SDG target 3.1 demands to reduce by 2030 the global maternal mortality ratio to less than 70 per 100,000 live births. Every year, 527,000 women in developing countries die of pregnancy related complications and nearly 4 million children die during their first month (Babinard, et al. 2006). As a consequence of bad access, walking remains the primary mode of transportation for women and their young children, thereby severely limiting their ability to reach needed care. It is estimated that 75% of all maternal

deaths in developing countries could be prevented by prompt access to qualified medical help (Babinard, et al. 2006).

Starkey et al. (2014) corroborate that "rural transport infrastructure and means of transport (including transport services) are crucial to overcoming the potentially fatal 'three delays' in health care (particularly perinatal care). These are i) the decision to seek health care, ii) the travel to reach care and iii) the treatment within the healthcare system (including referrals) and they all depend on access to transport. Where people are far from roads, their decision to travel is influenced by the problems of travelling by human porterage, stretchers, animals, bicycles or motorcycles. Good access to infrastructure and transport services are needed to ensure medical staff and supplies are available in health centres."

The impacts of rural access improvements on health can be subsumed as follows[9]:

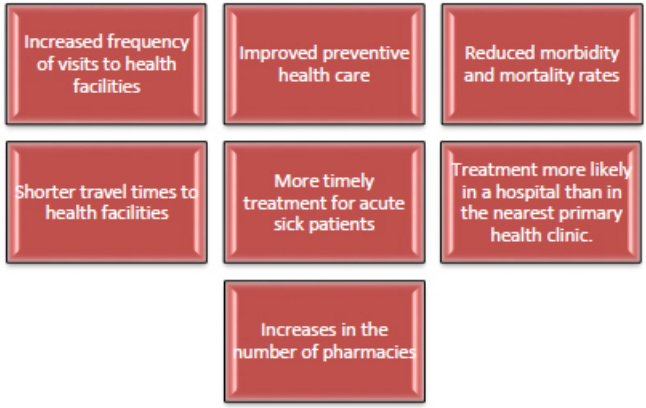

Figure 5. Impacts of rural access improvements on health.

[9] Afghanistan (USAID 2006), Bangladesh (Kandler/Bär 2004), Bangladesh (Khandker 2006), Brazil (Atsushi et al. 2015), Cambodia (KfW 2013), India (Bell et al. 2012, Banerjee 2015, Mohapatra 2007), Indonesia (Kwon 2000), Nepal (Trail Bridge Support Unit 2008), Dem. Rep. Congo (Ferf 2014), Papua New Guinea (Gibson et al. 2002), Peru (Escobal 2003), Philippines (Balisacan 2002), Viet Nam Glewwe 2002, Van de Walle 2002, Mu Ren 2008).

Research in India (Banerjee et al. 2015, Mohapatra 2007) shows, that the provision of roads increases the use of preventive health care by women and households, improves the management of infectious diseases, increases the attendance to emergencies and the frequency of visits by health workers. Improvement in antenatal and post-natal care was observed by beneficiaries, thereby decreasing obstetrics emergencies. Road connectivity and an improved transport system enabled families to opt for institutional deliveries in hospitals outside the village. Decrease in infant and child mortality was also reported.

Box 3. Interview with Church leader Manzini- Chefferie de Malumba, Kivu, Democratic Republic of Congo

However, in the past patients of this village needed to be carried by men to the hospital in Walungu (30 km) while when they died the body had to be carried back. In case the patient died after 15:00 there was no time to bring the body back, and it had to be buried there. If a taxi must be hired for transport of a sick person, this cost US$ 25. Sometimes they get it for US$ 15 when the owner is from the village.'

Source: Ferf et al. 2014.

4.4. SDG 4: Quality Education

An important means for rural families to escape the poverty trap is to provide quality education for their children. While primary school children reach their school mostly by walking, secondary schools are often too far away from the parent's homestead and daily or weekly commuting is frequent.

A vast amount of scientific literature shows that improved rural transport has very positive impacts on school attendance. For example in India school attendance rates rose by 22% as a result of a programme to expand the construction of all-weather roads in rural areas (Mukherjee 2011).

Figure 6. Ensure inclusive and equitable quality education and promote life-long learning opportunities for all.

The impacts of rural access improvements on education can be subsumed as follows[10]:

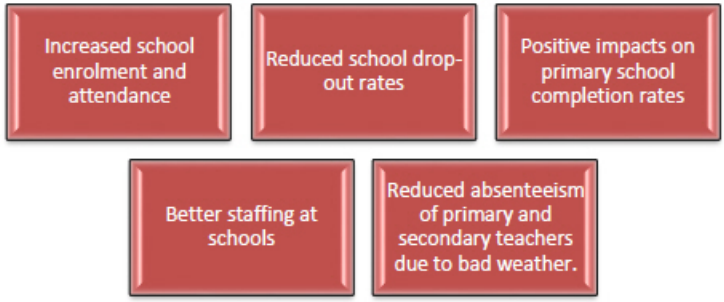

Figure 7. Impacts of rural access improvements on education.

4.5. SDG 5: Gender Equality

Transport burdens are unequally distributed between men and women. In Zambia, Uganda, Burkina Faso and Tanzania they carry three to five fold

[10] Bangladesh (Kandler/Bär 2004), Bangladesh (Khandker 2006), Brazil (Atsushi et al. 2015), Cambodia (KfW 2013), China (Cook et al. 2005), India (Bell and van Dillen 2012, Mohapatra 2007), Morocco (Levy 2004), Papua New Guinea (Gibson et al. 2002), Peru (Escobal 2003), Pakistan (Essakali 2005), Philippines (Balisacan 2002), Viet Nam (Mu Ren 2008), Zambia (Starkey (2007).

the transport load, measured in tonne-km compared to men. (Barwell 1996, p. 27, IFRTD). Women walk and spend much more time in transport. It is well documented that women suffer more from time poverty in rural areas, as they not only have to work the fields, but bear children and care for their families at the same time.

Figure 8. Achieve gender equality and empower all women and girls.

Bad access to services, especially health services, is determining the well-being of many rural women. Presently, women in rural areas are still up to three times more likely to die while giving birth than women living in urban centres[11]. Good rural access reduces this risk tremendously. Several authors mentioned positive impacts of rural roads on women with the key indicator being increased female visits of health centres.

Improved nutrition from a more varied diet engendered by new products brought in with better road connections can help women to be stronger physically. Additionally, the ability to buy a wider variety of goods at better prices can also have had a beneficial impact on their families, and the growth of children. In addition, women often are able to benefit from the opportunities to develop small entrepreneurial activities associated with the increased economic activities (World Bank 2010).

Women have less access to private means of transport, such as bicycles, motorcycles and cars. Therefore women are much more dependent on public transport services. Cook (2005) ascertains that "women, particularly poor women are often at risk by the lack of or poor quality of transport services.

[11] http://www.un.org/sustainabledevelopment/inequality/.

Reliable transport seems particularly important in encouraging parents to allow girls to continue their education, and in enabling women to participate in social and economic activities, outside the village." Consequently, an improvement of rural access which usually entails better transport services will be to the benefit of women.

Negative effects of roads are mentioned by Sieber and Allen (2016). They tend to increase inwards and outward flows of goods and people and they may accelerate the depletion of the population in rural areas. Able bodied men and young adults are more tempted to escape to cities in the quest for better paid jobs. Better access can, therefore, leave older people and women with children stranded in the outlying rural areas while men leave to work in peri-urban or urban areas for the high wages than they are able to command from agricultural activities.

4.6. SDG 8: Decent Work and Economic Growth

Figure 9. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Often rural households seek to diversify their livelihood base as a way to reduce risk. Rural transport can provide access to other sources of income, such as employment, trading or offering other services. These dynamics are fundamental for rural development.

Asher et al. (2015) compiled large datasets from India's rural road construction program that has built paved roads to over 100,000 previously unconnected villages since it began in 2000. The authors find "that rural

roads increase economic well-being, as measured both by household earnings and night light luminosity." New road constructions to previously unconnected villages led to a 10% point reduction in the share of households and workers in agriculture, with an equivalent increase in wage labour market participation. The authors interpreted these findings as evidence that rural roads facilitate structural transformation by increasing the access of rural workers to external labour markets, either via commuting or short-term migration.

Additionally, Mohapatra et al. (2007) observed that in India after the construction of roads, there was an improvement in the number of job opportunities, more avenues for self-employment and possible economic activities. Farming employment opportunities also increased due to a shift to higher earning cash crops and also to multiple cropping.

Figure 10. Impacts of rural access improvements on employment.

There is overwhelming scientific evidence that improved rural access has strong impacts on employment[12]

One of the most important findings is related to the graduation process in the labour market, which is an essential feature of a development process. Randa (2011) evaluated the employment-generating impact of rural roads in Nicaragua and observed "tendencies of a graduation process taking place in the labour market: individuals moving out of unemployment predominately achieve employment in the agricultural sector (self-employment), whereas newly created service sector jobs primarily are taken by workers previously working in agriculture. The analysis suggests that the employment-generating effect comes through a combination of reduced travel time and better access to markets and larger, more integrated road networks." Often the new jobs are created by small businesses located in the service sector.

The creation of new employment is an appropriate indicator for a dynamic development process stimulated by improved rural access. The macroeconomic effects in China were analysed by Fan (1999, 2000), as described in Box 4.

Box 4. Macroeconomic effects of rural roads in China

In China government spending on rural infrastructure (roads, electricity, and telecommunications) helped reduce poverty and inequality substantially, mainly due to improved opportunities for nonfarm employment and increased rural wages. In China for every Yuan invested in rural roads, 9 Yuan in rural GDP is produced. Roads yielded the largest return to rural nonfarm GDP, 35% higher than the return to education investment.

Source: Fan 1999, 2000.

As already explained above, rural growth in China was generating the demand that stimulated the unprecedented growth of national industries that enabled China to become what it is today.

[12] Bangladesh (Khandker et al. 2006), China (Fan 1999, 2000), India (Asher et al. 2015, 2016), Mohapatra et al. 2007), Mozambique (Thompson, et al. 2012), Nicaragua (Randa 2011), Peru (Escobal 2003), Viet Nam (Mu Ren 2008).

4.7. SDG 9: Industry Innovation and Infrastructure

Figure 11. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The SDG target 9.1 specifies the goal with the terms "quality, reliable, sustainable and resilient infrastructure … with a focus on affordable and equitable access for all." In order to operationalise this target, the indicator 9.1.1 "proportion of the rural population who live within 2 km of an all-season road" was developed. Applying this RAI indicator, globally 1 billion people do not have access to transport, and 98% of those without access live in developing countries (Roberts 2005).

SDG 9 directly provides guidance for rural access improvements. However its operationalisation is related to a number of difficulties and challenges that need to be solved when implementing SDG 9.

4.7.1. Improve Maintenance of Rural Roads

Road and rail networks are the largest assets and liabilities for national governments in low and middle income countries. For example US$16.2 billion per annum is invested in transport infrastructure in sub-Saharan Africa alone (Global Mobility Report 2017). The importance of roads is further reflected by the fact that spending on roads can absorb as much as 5 to 10 percent of a governments recurrent expenses and 10 to 20 percent of its development budget (Heggie, Vickers 1998).

It is the sad truth in many industrialised and developing countries that transport infrastructures are not adequately maintained, which is especially

true for rural roads. Chongvilaivan (2015) found in Timor-Leste that proximity to roads alone may not necessarily result in improved welfare, since roads are often in a bad condition. Instead, ensuring all-weather access to roads appears to be a more significant factor in raising household well-being. Specifically, road accessibility during the rainy season is regarded as essential. "This suggests that in Timor-Leste, and likely in other developing economies under similar conditions, maintenance of existing roads is more essential to well-being than building more roads." Bad roads make travels more expensive, increase local commodity prices, reduce agricultural profits, and prevent modern value chains and transport services to reach the village. The impacts of road investments, often financed by donors, can disappear in a few short years. Insufficient public budgets for road maintenance, low priorities for rural roads and poor management by road authorities are all stated as reasons.

Generally, government's maintenance spending is by far not sufficient for the whole network: The World Bank[13] states that many countries in South Asia spend just 20–50% of what they should be spending on maintenance of their road networks. The poor state of the road network is reflected in the large backlog of deferred maintenance. The economic costs of poor road maintenance are borne primarily by road users. When a road is allowed to deteriorate from good to poor condition, each dollar saved on road maintenance increases VOCs by between $2 and $3 Rehabilitating paved roads every 10 to 20 years is more than three times as expensive, in cash (Heggie Vickers 1998). Since sufficient funds are not available, priorities are rightly set to maintain the core network which has larger traffic volumes than rural roads. Taking into account the value of the infrastructure assets, a policy to save public funds on maintenance entails huge diseconomies.

> For every US $1 not invested in road maintenance, road users waste US $3 on extra transport costs - and the road must still be repaired. Source: DFID/PIARC 2000.

[13] http://go.worldbank.org/MT3DQY2BX0, see as well Metschies (2006), p. 22.

However, the impression is that world-wide – industrialised countries such as Germany not exempted – political will is missing to either collect sufficient revenues or to earmark the funds for the road sector. Even if sufficient funding is provided, often new construction projects are favoured by politicians. This policy is again a large diseconomy, since the highest returns on road investments are achieved by road maintenance, followed by rehabilitation and new construction[14].

In order to meet the requirement of sustainability, Goal No 9 should not only focus on new road investments, but give road maintenance a high priority. The SDG process may contribute to a change in attitude that changes the attitude of decision makers and generates a dedicated political will to strengthen existing procedures and institutions and adequate sources of funding. An external monitoring through the SDG process would help governments to adequately maintain their rural roads.

4.7.2. Increase Road Funding

Ruiz-Nuñez (2015, p11) estimated that world-wide transport requires roughly one third of total infrastructure investments, of which 70% (!) should be dedicated to maintenance. As has been demonstrated above, if the SDGs shall be successful, major investments in rural roads are needed. A large share of these means needs to be covered from national sources, since donors are usually not willing to finance recurrent expenditures. The user pays principle is considered as adequate for financing of roads and the fuel taxation is the easiest way to charge the road users. The German International Cooperation GIZ provides world-wide data on fuel taxation[15]: In 2014 diesel was subsidised in 20 countries, 30 countries applied a fuel taxation that covered maintenance expenditures and another 30 countries, mostly in Europe, exceeded this level. Thus, there is sufficient leeway for many countries to increase user based funding of road investments. A rough assessment for two countries reveals that the magnitude of 12 US$ cent per

[14] As rule of thumb practitioners quote the IRR for maintenance at 40%, followed by rehabilitation 20% and new construction 10% (Dr Metschies GIZ, not published).
[15] International fuel prices: https://www.giz.de/expertise/html/4282.html.

litre of fuel is sufficient to finance the maintenance of a country's whole road network[16].

Donors are presently considering alternative funding arrangements, including results-based funding with payments made following the completion and verification of rural infrastructure provision and maintenance, with pre-financing by the local government. This requires greater transparency as a 'pre-condition'. Such arrangements reward good governance, with phased payments made on the achievement of appropriate milestones. Specific components of such a funding model may include incentive payments for good governance.

4.7.3. Reduce Corruption

The construction sector is especially affected by corruption. Transparency International's 2002 Bribe Payers Index[17] reported that construction/public works are perceived to have the highest level of bribery of any sector, higher than both the arms industry and the oil and gas sector. Transport experts joke about a 'concrete index' in transport projects - the more concrete is used in the project, the higher the level of corruption. United Nations Conference on Trade and Development UNCTAD states that "the ones who suffer most from corruption are the poor" (Boehm et al. 2008, p.8).

Measures how to fight corruption in the road sector cannot be detailed here, but they have been provided by the author (Sieber 2013). One of the most important actions is the establishment of transparent Road Asset Management Systems.

4.7.4. Road Asset Management

The deficits in road maintenance and the vulnerability of the sector to corruption are the main reasons why Road Asset Management Systems need to be established. A more comprehensive and inclusive approach is needed,

[16] Inflation adjusted to 2018, plus annual vehicle taxes. Examples: i) USA Federal Trust Fund and the US State Road Funds are both financed by an average fuel levy of US$ 0.10 per litre. ii) Calculations for Rwanda by Metschies (2006).

[17] https://www.transparency.org/research/bpi/overview.

that encompasses at least a road inventory, surface condition, traffic volumes, prioritisation and costing of road works, e-procurement procedures, contractor management and evaluation. One of the most important features should be a life cycle costing approach that prioritises road investments on the basis of investment, routine and periodic maintenance cost. Another advantage of these systems might be transparency, since the same information could be made available to all relevant stakeholders. However, often the political will for transparency is missing, which again might be an issue laid down in the SDG.

4.7.5. Low Cost Access

The question arises if each village needs to be accessed on a sealed all weather road that requires large investments. The discussion about low cost infrastructures is well known amongst rural transport experts: spot improvement and appropriate design for light vehicles are solutions as well as tracks that may be used by motorbikes. Selection of appropriate treatments should focus on achieving the access target at minimum cost, with prioritization based on cost-effectiveness, e.g., per head of population served. Only at higher traffic levels, conventional cost benefit analysis applies.

4.7.6. Feeder vs Trunk Roads

Another debate is on whether road investments reap larger benefits when placed on feeder or trunk roads. Starkey and Hine (2014) suggest that the improvement of local networks is quite positive, since "building roads (and/or trails and footbridges) to connect rural communities to the road network provides numerous benefits and reduces the numbers of people in extreme poverty." A study of public investments in rural Uganda (Fan et al. 2004) suggested that the most basic 'feeder' roads had a benefit-cost ratio of 7.2, with 34 people taken out of poverty for every million shillings invested. The benefit-cost ratios of gravel or tarmac roads were not significant while the impact of small feeder roads on poverty reduction was three times greater than gravel or tarmac roads, per unit of investment. Thus the impact of low-grade roads such as feeder roads is larger than that of high-grade roads such

as murram and tarmac roads (Fan 2004). This was confirmed by Starkey and Hine who suggested that the most cost-effective way to reduce travel time was to invest in minor rural roads.

The above positive assessments are somewhat contradicted by Raballand (2009), who observed in Cameroon that "isolation from a tarred road is found to have no direct impact on consumption expenditures in Cameroon." Qiaolun Ye (2006) undertook an extensive ex-post evaluation on the poverty impacts of the Southern Yunnan Road Development Project in China. The author concludes that a "better alternative could have been upgrading roads in other parts of the county that had high potential for commercial agriculture, such as areas adjacent to towns, or large villages in lowlands with sufficient land and favourable conditions, such as sufficient water, even if they are not poor."

4.7.7. Roads Are Not Enough: Transport Services Need to Be Improved

Since ownership of private vehicles is scarce in rural areas, transport services provide the only way to travel longer distances. In many situations, it is the inadequate maintenance of rural roads and the lack of an appropriate regulatory regime for rural transport services that inhibits the development of effective low volume and local passenger and freight transport systems. This reduces opportunities to connect rural inhabitants to markets and services. Often, one rural access is improved, transport services increase and the competitive environment causes service quality to increase while prices decrease.

4.7.8. Development of the Rural Access Indicator

The rural access indicator RAI, mentioned above in this section, is foreseen as an SDG Indicator 9.1.1 to measures rural access to an all season road. The indicator was adopted in 2018, as Tier II indicator, a classification normally applied to indicators with an agreed methodology for measurement. To progress initial measurements are needed for a significant number of countries. In addition, it must be possible to demonstrate that

measurement will expand to a larger number of countries, and that measurements will be repeated.

The latter is a major challenge, since the transport sector as a whole has a paucity of data. Many road networks in Africa are growing rapidly and road authorities are struggling to keep pace with this growth and consequently they often neither know the exact extent of their road network nor its overall condition. Donors are presently updating the methodology to take advantage of new technologies, such as high resolution satellite imagery, crowd sourcing information, OpenStreetMap, big data, drones, high definition videos, road condition analysis apps for smart phones, etc..

The World Bank, with the support of DFID, has devised a new, GIS-based RAI with the aim is to create a more accurate, operationally relevant and cost effective RAI that will also aid in monitoring improvements in accessibility. Ongoing research (Vincent 2018) confirmed that the original survey methodology, which defines access to transport as the share of the rural population living within 2 km of the nearest all-season road, is considered as appropriate. However, a new methodology document should be prepared that includes household-survey-based methods and GIS-based methods.

The authors raise concerns that "the RAI does not truly reflect the realities of contemporary rural access in some countries, for example where vehicles other than four-wheel vehicles are used, and conventional all-season roads are not essential. To accommodate this concern at the national level, it is proposed that an additional country RAI could be calculated taking such factors into account." Additionally, the authors propose an SDG indicator, which can take into account access to facilities such as health centres, schools and markets, and also the existence of appropriate and sustainable transport services.

4.8. SDG 10: Reduced Inequalities

This goal does not specifically mention rural-urban disparities, but it is implicit in this goal, since three quarters of the poor in the developing world

reside in rural areas (World Bank 2013). Essential disparities exist in the field of education, nutrition, and health care, as well as for mortality and fertility rates. Access to safe water, sanitation, and health services plays a critical role. The impacts of rural access improvement on the goals previously described contribute as well to the achievement of this Goal No 10.

Figure 12. Reduce inequality within and among countries.

4.9. SDG 13: Climate Action

Figure 13. Take urgent action to combat climate change and its impacts.

Target 13 seeks to strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries.

Obviously, improving or building new roads will have negative impacts on climate change through the emissions released during construction and by additionally generated traffic volumes. The latter may be regarded as a consequence of the desired development process, which requires growth of the transport in order to generate the development impacts. Both effects may be alleviated through climate friendly construction methodologies and low emission vehicles. Another negative impact of rural roads may be that they provide access to natural resources, especially natural forests. 'Their exploitation has proven in the past to be detrimental to the local environment, to biodiversity and climate.

Additionally, current and future climate threats pose a significant risk to rural access. Low volume roads are presently justified if they are designed, constructed and maintained using low-cost methods. This makes low volume roads more vulnerable to climate risk than high volume roads. Therefore most existing rural networks are currently climate-resilient deficient and climate adaptation is imperative.

CONCLUSION

The Sustainable Development Goals shall be the guiding principle for future cooperation with the developing world, replacing the Millennium Development Goals. This paper argues that the improvement of rural access in Developing Countries is essential for the success of the SDGs.

Poverty is predominantly rural and agriculture is the main source of income. Globally, one billion people are disconnected from markets, jobs and services. Bad access forces them to continue with subsistence production, they remain unemployed, uneducated and poor. Isolated people are more often sick, and too many – especially pregnant women and children - die before seeing medical service.

The present focus on urban areas neglects that rural development is important for sustainable national growth, food security and reduction of disparities. Improved rural access is indispensable for rural development and supports 9 out of 17 SDGs.

Goal number 9 "Industry Innovation and Infrastructure" targets directly rural access improvements. A vast quantity of scientific publications confirms the positive development impacts of rural roads in developing countries. However the conclusion would be wrong, that development would be automatically stimulated if each village is connected to an all-season road. Road access is a condition sine qua non, but not sufficient per se. Therefore, the economic potentials for a local economic growth have to be taken into account before investing. If the potentials are not given, rural roads can only be justified with social equity arguments. The policy of China, to resettle whole villages from remote areas with very low economic potentials may be controversial, but worth a debate. Instead of investing in costly roads, China's strategy is to provide the resettled inhabitants with the means to increase their income, such as agricultural land, irrigation schemes and housing for the whole village.

However, a number of tasks remain before SDG goal 9 can be operationalised. First of all, the Rural Access Indicator needs to be further developed to serve as an adequate measure. Proposals exist to include transport services and access to facilities as well, but it is unclear how these objectives may be operationalised.

Clearly, rural roads need additional funding in order to contribute to the SDGs. However, funding alone will not solve the problem, if corruption is not curbed and maintenance improved. Both represent large scale diseconomies that need to be urgently tackled. Neglecting maintenance of the states' largest assets is a huge waste of resources. The SDG process can contribute to generating the political will that is needed to change the present system. Additionally, political pressure can be created though monitoring of maintenance efforts of aid-recipient states.

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ANNEX 1. IMPACTS OF RURAL ROAD IMPROVEMENTS

Ex-post impact assessments of rural road improvements

Country	Author	Year	Transport Improvements					Social and Economic Impacts					
			Visit / access to health Services	School enrolment/ completion	Visit of other services	Transport services	Transport costs	Market Activity	Income / Wages /consumption	Non-farm employment	Agricultural profits / production	Effects on poverty	Effects on women
Afghanistan	USAID	2006	+			++	++	+	+		++		
Asia	Cook	2005										+	++
Bangladesh	Kandler/Bar	2004	+	+	+	+	+	++	++	+			
Bangladesh	Khandker	2006	+	+			+		+		+	+	+
Brazil	Atsushi et al	2015	+	+		+			+-	+-	+-		
Cambodia	KfW	2013	+	++		+	+	++	++		+		+*
Cameroon	Raballand	2009								++			
China	Cook et al	2005		+					+	++		++	++
China	Fan	2000							++	++			
China	Fan	2005									++	++	
China	Jalan et al	2002							+				
China	Qiaolun Ye	2006		+-						++	+-	+-	+**
Ethiopia	Dercon et al	2007			+				+		+	+	
India	Asher	2015							++	++			
India	Banerjee	2015	++										++
India	Fan	1999							++	++	++	++	
India	Fan	1999									++	++	

Country	Author	Year	Transport Improvements					Social and Economic Impacts					
			Visit / access to health Services	School enrolment/ completion	Visit of other services	Transport services	Transport costs	Market Activity	Income / Wages /consumption	Non-farm employment	Agricultural profits / production	Effects on poverty	Effects on women
India	Mohapatra	2007	++	+				+	++			++	
India	Raychudhuri,	2004							++		++		
Indonesia	Gertler et al	2014							+	+	++	+	
Indonesia	Kwon	2000	+									++	
1.1.1.1 Dem o	Ferf	2014	+					++	++			+-	
Lao PDR	Warr	2006										+	
Papua New Guinea	Gibson et al	2002	Very general impact assessment									+	
Peru	Escobal	2003	+	+	+					++	+		+*
Philippines	Balisacan	2002	+	++					+			++	
Viet Nam	Glewwe	2002	+									++	
Viet Nam	Van de Walle	2002	++		-	+			+	++		++	
Viet Nam	Van de Walle	2009	+	+	+			+		+		+	
* female visits of health centres ** Women involved in road maintenance													
Impacts:	++ very positive		+ positive		+- neutral		- negative						

Source: Sieber and Allen 2016.