IMPACTS OF RURAL ROADS ON POVERTY AND EQUITY

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ABSTRACT

The last 20 years has seen a considerable number of studies undertaken in order to assess the impacts of rural roads. This paper is the result of a meta-analysis of a number studies taking into account the impacts of various access and mobility issues. Contrasting opinions amongst the authors of the studies were noticed. A number of authors argue that rural roads should be improved in locations where poverty is most severe as improvement in access to markets provides opportunities for subsistence farmers to integrate into the market economy. Others argue that rural road access should be primarily improved in locations where economic opportunities are already better, and thus accelerate a dynamic process for commercial farming and manufacturing.

It was widely agreed that rural roads have considerable positive impacts on poverty. However, it should be emphasised that while roads are condicio sine qua non for development, they are not sufficient to generate poverty reduction on own. The ability of the poor to derive economic benefits from the use of roads depends on their asset base and the entitlements to resources and opportunities. Additionally, many authors claim that making access improvement, such as upgrading of paths, tracks and feeder roads; have a stronger effect than improving the main road network.

Most of the studies focused on the effects of road investments, but did not take into account the aspect of sustainability or gender. This paper looks at some conflicting arguments and also to what extent this may have a positive or negative effect on environmental and social sustainability. The unfortunate reality in many developing countries is that roads are not adequately maintained and he full benefits or road investments can be only realised if the roads are well maintained.

INTRODUCTION

The period between mid-2015 and the end of 2016 has been an important one for the international political agenda. The Sustainable Development Goals (SDGs), the Paris Agreement on Climate Change and the New Urban Agenda have all been agreed and transport as a cross cutting issue is critical to delivering many of their ambitions. Rural accessibility receives attention as an indicator for several of the SDGs (such as 1.4 – poverty alleviation) and, consequently, these highlights the developmental effects of improved rural accessibility. This period has also seen a considerable number of studies[3] undertaken in order to assess the impacts of rural roads. An overview on the impact studies is given in the annex[4].

It is widely agreed that rural roads have considerable positive impacts on poverty. However, while roads are *condicio sine qua non* for development, they are not sufficient to generate poverty reduction on own. The ability of the poor to benefit economically from these roads depends on their asset base and the entitlements to resources and opportunities. This paper looks at some conflicting

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[3] Asher 2015: India, Atsushi et al 2015: Brazil, Balisacan et al 2002: Philippines, Banerjee 2015: India, Chongvilaivan 2016: Timor-Leste, Cook 2005: Asia, Cook et al 2005: China, Dercon et al 2007: Ethiopia, Escobal 2003: Peru, Fan et al 1999: India, Fan et al 2000: China, Fan et al 2005: China, Ferf 2014: Democratic Republic of Congo, Gertler et al 2014: Indonesia, Gibson et al 2002: Papua New Guinea, Glewwe et al 2002: Viet Nam, Hettige 2006: Asia, Jalan et al 2002: China, South, Kandler/Bär 2004: Bangladesh, KfW 2013: Cambodia, Khandker 2006: Bangladesh, Kwon et al 2000: Indonesia, Mohapatra 2007: India, Qiaolun Ye 2006: China, Raballand 2009: Cameroon, Raychudhuri 2004: India, USAID 2006: Afghanistan, Van de Walle 2002: Viet Nam, Van de Walle 2009: Viet Nam, Warr et al 2006: Lao PDR
[4] The time period for the literature review is some 20 years.

arguments and also to what extent this may have a positive or negative effect on environmental and social sustainability.

The distinction between urban and rural areas has become unclear as they start to converge and overlap. There is more of a continuum between rural and urban areas and this is becoming apparent in regard to migration movements, multi-local livelihoods as well as increasing flows of goods, resources, capital and information. It is also being recognized in the international political agenda – as part of the new Sustainable Development 2030 Agenda. The accompanying Sustainable Development Goals and the New Urban Agenda agreed at Habitat III in the autumn of 2016.

This paper provides an overview of the most important findings retrieved in 26 scientific studies on rural roads in developing countries. This paper discusses the following impacts of rural roads:

- Agricultural production and marketing;
- Transport induced local market development;
- Wages, consumption and employment;
- Poverty impacts and alleviation;
- Transport speeds, costs and patterns;
- Access to health services and education;
- Investment in feeder roads vs trunk roads; and
- Gender aspects.

Increasing connections between isolated communities in rural areas and markets is vital to improving agricultural returns. Accessibility can be understood as the ease of reaching desired destinations given a number of available opportunities and the intrinsic barriers to travel from the origin to the destination. Barriers to access in the context of transport can be defined not only through travel speed and costs, but as well seasonal and weather-dependent accessibility. Usually, opportunities are measured in terms of employment, and impedance in units of distance or time (Niemeier, 1997). Many authors have complemented this view of accessibility by adding and developing existing and new components to the approach, constructing a wider theory about accessibility. Wee and Hagoort (2001) identified three main clusters to define accessibility measures: infrastructure-related, activities-related and mixed approaches.

Experience from KfW projects (Box 1) shows a wide variety of impacts. The studies reviewed found impacts in terms of:

- Transport Improvements:
  Improved access to markets, health services, school enrolment and completion, visit of other social services, increased transport services and lower transport costs.
- Social and economic impacts
  increased market activity with increased farm gate and market returns, income, wages, consumption, non-farm employment, agricultural production and less waste, poverty alleviation and some positive impacts on women.

Box 1: Impacts of the Rural Infrastructure Program II in Bangladesh

The German Financial Cooperation with Cambodia (KfW 2013) conducted a major impact assessment study about their Rural Infrastructure Program (RIP) II in Bangladesh and observed a number of positive effects.

- An average increase of 197 per cent on annual household income among respondents across nine influence areas.
- A reduction of about 37 per cent on total annual household transport cost.
- A reduction of about 15 per cent on the average "unit transport cost"
- A reduction of 56 per cent on average transport time.
- An increase of 86 per cent on average daily traffic along the programme roads with 139 per cent increase for motorized vehicles.
- A small but relevant increase of 0.65 per cent on primary school attendance.
- A remarkable increase of 26 per cent on the lower secondary school attendance, as well as an increase of 16 per cent on the upper secondary school attendance.
- More people are availing the health services from the health centres, the record showed an increase of 36 per cent in total average.
- Agricultural production has the following increases, rice (11 per cent), grains (4 per cent), cassava (146 per cent), fruits (16 per cent) and vegetables (23 per cent)
- Almost three quarters (74 per cent) 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.

IMPACTS ON AGRICULTURAL PRODUCTION AND MARKETING

Starkey and Hine (2014) conducted a large scale literature review on transport and poverty assessing 360 documents on transport. 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. Studies in Ethiopia, India and Nicaragua showed increased fertiliser use, higher yields, enhanced production, employment, living standards and poverty reduction. The effects of improved rural transport on agriculture and poverty can be complex. Better road access leads to price changes in inputs and outputs and may affect cropping patterns, land prices and land ownership. It also provides various new opportunities for employment, immigration and emigration. How individual poor households are affected depends on local circumstances. People with resources are most able to adapt to changing market conditions and economic opportunities."

Rural roads are particularly critical to agriculture, which is the main source of income in rural areas. In India a large rural transport programme (Mohapatra et al 2007) made it easier to transport agricultural inputs to villages, which has led some farmers to switch from food crops to cash crops (such as ginger, jute, sugarcane, sunflower). Similar results were observed in West Bengal where agricultural productivity increased and that helped to raise income levels and expand household consumer choices among poor farmers (Raychudhuri, 2004).

TRANSPORT INDUCED LOCAL MARKET DEVELOPMENT

The above findings confirm the theory developed by Ren and van de Walle (2009) of TILD (Transport Induced Local Market Development) through the improvement of rural roads. From their research on the rural roads and local market development in Viet Nam, they found "significant average impacts on the presence and frequency of markets and on the availability of various services." Improving transport not only allows farmers to export their produce, there are also inward flows of goods that can improve the quality of life of local citizens, as well as non-commercial activities such as knowledge flows and new ideas. Examples are given in Box 2.

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Box 2: Road impacts in Afghanistan and Uganda

Impacts of rural roads in Afghanistan

In Afghanistan, USAID (2006) rehabilitated 49 rural road segments within their Rebuilding Agricultural Markets Program (RAMP). As an effect of this programme, the volume of net surplus exported from the treated villages increased, farmers got better prices for their products as they were able to transport their products to main markets and sell at competitive prices. The research found that opportunities for commercialization of agriculture within the zone of influence were far better with rehabilitation of the roads. Observations during the survey and PRA interactions with local informants indicate that the roads have also improved access to people traveling to district agriculture departments and medical centers. Local shops are fully stocked with merchandise items and prices are reasonable. A number of new economic initiatives have also sprung in some locations, like mills and workshops. Although it is difficult to attribute these developments entirely to the rehabilitation of roads, it is quite clear that the roads have provided the impetus for increased agricultural output and incomes.

Source: USAID (2006): Rebuilding Agricultural Markets Program (RAMP)

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 rehabilitation roads, build markets and introduce agro-processing equipment took a community-based approach to providing agricultural infrastructure and raising the incomes of farmers. A high level of participation from residents of local communities helped to set priorities, select labour-intensive projects to build or improve agricultural infrastructure and maintain it after completion. The rehabilitated 3,089 km all-weather rural roads and over 200 rural roads. 52 rural markets were constructed and numerous assorted agro-processing equipment units placed. It raised awareness in local communities and mobilized residents to participate in taking inventories, setting priorities, and selecting projects to build or improve agricultural infrastructure and to maintain it after completion.

Since 2008, the project area has seen the proportion of marketed agricultural produce increase by 7.5 per cent, farm gate prices up by 36 per cent, post-harvest losses reduced by approximately 20 per cent and a 40 per cent rise in household income. Meanwhile, travel costs have dropped by 63 per cent. Other benefits include: the emergence of rural growth centers and more permanent housing; new schools and health facilities; higher school enrolment; better health, inter alia, because of more numerous antenatal visits to health centers especially for expectant mothers.

Source: African Development Bank

Evidence from Kivu Region in Eastern Democratic Republic of Congo (Ferf 2014, see Box 3) shows, that rural roads play a role in the economic growth of central villages (hubs), in particular through the growth in numbers of restaurants and shops. Roads stimulate the demand for construction materials and other consumer products from rural areas. To a lesser extent, residents observed an increase in the demand for local products as well as a small improvement in prices for their products and an improvement in the supply of consumer goods. This confirms the statement that roads are a precondition for local development, but the dynamism of this process depends very much on local economic potentials, such as agro-ecological potential, training levels or available risk capital.

Box 3: Roads and markets in Kivu District, Democratic Republic of Congo

Even poor people can now sell goods at the market or along the road. Before upgrading the road, there was no demand for products. In the past, products like salt and soap were not regularly available. These things are now available. They are expensive, but prices are slightly lower than before.

Source: Interview with local inhabitant in Ferf et al (2014)

Steyn et al (2014) raised an issue which has been rarely researched by investigating road roughness and the damage of produce (in this case tomatoes) transported on rural roads in California. Even though damage was clearly demonstrated, the research was not conceived in a manner to assess the impacts on prices due to damaged products. However, the effects of improved riding quality were observed by the above mentioned USAID Program (RAMP, 2006). Farmers started to grow high-value vegetables in larger quantities, presumably because the spoilage and loss associated with poor roads had fallen by 50 per cent. Most crops in the treated villages also showed higher yields than in control villages, arising from increased intensification of input use and higher cropping intensities. Therefore the RAMP Program attributed about 40 per cent of the total benefits to increased agriculture production and marketing, 26 per cent was due to reduced transport costs accrued to farmers, and the remaining 33 per cent were savings made by transport operators by way of reduced vehicle operation costs.

Some authors critically question the above findings: Van de Walle (2009) is critical about the impacts of rural roads on market development. She suggests that "small road improvement projects could have vastly larger impacts on local market development if they were targeted to places with initially lower market development, and equally important, accompanied by complementary social and economic policies aimed at improving certain attributes (e.g. adult literacy) or reducing the disadvantages of others (policies to reverse the effects of historical discrimination towards ethnic minority groups) that interact with roads to reduce their impacts."

In theory, producer prices increase after road rehabilitation due to the lower transport costs which are transmitted to local producers in a competitive transport market. This evidence is supported by the above RAMP Program example however, the theory is also contradicted in a scientific very credible research conducted in Sierra Leone (Casaburi 2013) which shows, that improved roads reduced market prices of local crops. These price effects were stronger in markets that are further from major urban centres and in less productive areas. In addition, these price effects are reversed in areas with better cell phone penetration. The latter is probably the explanation, since cell phones enable farmers to receive market price information and give them a better bargaining position with traders, especially in remote areas.

IMPACTS ON WAGES, CONSUMPTION AND EMPLOYMENT

One of the most frequent observations was the shift from agricultural self-employment to wage-earning employment. 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 per cent 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.

Van de Walle (2009) confirmed that after road constructions rural households in Viet Nam were switching from agriculture to non-agricultural, mostly service-based, activities. Research by Escobal (2003) in Peru "presented evidence of the impact of road rehabilitation on the importance of waged sources in rural household's income generation strategy…Furthermore, it recognizes non-agricultural wage income as the main source of positive impact of both motorized and non-motorized roads rehabilitation in the short-term." Road improvements in Bangladesh (Khandker et 2006) also had a significant impact on men's agricultural wage (increases by 27 per cent), fertilizer price (fell by about 5 per cent) and aggregated crop indices (price indices increased by about 4 per cent…, while output indices rise significantly by about 38 - 30 per cent). The overall effect of road improvement on household per capita annual consumption was 11 per cent.

Randa (2011) evaluated the employment-generating impact of rural roads in Nicaragua. He observed "an increase in hours worked per week attributable to the intervention of around 9.5–12.3 hours. Moreover, he observes 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."

IMPACTS ON POVERTY

The major question for development cooperation is how the above described impacts affect rural poverty. 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 investment of 10 Million Rupies in roads lifts 1,650 poor persons above the poverty line. This is equivalent to an investment of only 140 US$ per poor person[4].

Improvement in agricultural productivity not only reduces rural poverty directly by increasing income of poor households, it also causes decline in poverty indirectly by raising agricultural wages and lowering food prices (since poor households are net buyers of food). Similarly, increased non-farm employment and higher rural wages also enhance incomes of the rural poor and consequently, reduce rural poverty. The total productivity effect on poverty, some 75 per cent arises from the direct impact of roads in increasing incomes, 15 per cent arises from lower food prices and 10 per cent from increased wages.

Fan et al. (2000) examined the factors which contributed to the exceptional growth and to the reduction of poverty in China over the past decades. 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. Among the three infrastructure variables considered, roads had the largest impact. They concluded that that with every 10,000 Yuan (about $1200) spent on rural roads eleven persons are lifted above the poverty line. In terms of impact on growth, for every yuan invested in roads, 8.83 yuan in rural GDP is produced. Roads yielded the largest return to rural nonfarm GDP, at 6.71 yuan for every yuan invested, 35 per cent higher than the return to education investment.

Cook et al (2005) looked at the impact of transport and energy investments in projects conducted by the ADB and the World Bank in China, Thailand and India. They concluded that most of the poor do appear to benefit proportionally from rural infrastructure investments and reduction in travel times in the medium term, although some could be marginalised. In China, they observed a better performance in poverty reduction in villages with road access. Smoother and faster motorized road transport also facilitated a shift to higher-value perishable products. Households, both poor and non-poor, substantially increased the share of their income coming from off-farm employment over this period.

Khandker et (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 improvements of about … 5-7 per cent. Thus, had the duration of road pavement taken about 5 years, we could argue that each year poverty fell by about 1 per cent, solely due to rural road improvements." Road investments are pro-poor, meaning the gains are proportionately higher for the poor than for the non-poor. The results suggest that the savings of household transport expenses are quite substantial, averaging about 36 - 38 per cent in the project villages.

[4] 1999 exchange rate

A number of other studies corroborate the above findings:

- 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 per cent points (Warr, 2006).
- 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 per cent higher probability of escaping poverty than those in communes without paved roads.
- Dercon (2007) confirms the above findings through a research in Ethiopia, which revealed that "access to all-weather roads increases consumption growth by 16 per cent and, reduces the incidence of poverty by 6.7 per cent."

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. In particular, although the time needed to walk to various places declined overall, time savings were more pronounced for the poorest 40 per cent of households." 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."

Starkey and Hine (2014), in their comprehensive literature review, gave a more sceptical appraisal of these types of benefits: "Where transport investments have stimulated economic growth, the poor have often benefitted only marginally – in many cases, they have not had the resources to take advantage of the opportunities afforded by better access. 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."

This scepticism 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 (see as well Box 4 and, Hettige, 2006; Raballand et al, 2010; Khandker et al 2011; van de Walle et al, 2011). From an impact analysis of rural road projects and integrated rural projects in Asia (one of each type in Sri Lanka, Indonesia and the Philippines) Hettige (2006) concluded while communities and the poor benefitted, there was little evidence that the 'very poor' benefited from the roads.

Box 4: Road impacts on extreme poverty

Duncan (2007) argues that "transport planning for poverty reduction must take into account that poverty is not so much a village as a household phenomenon. There are poor households in well-off communities, and well-off households in poor and disadvantaged communities. Experience shows that bringing transport to a community initially creates benefits for the relatively rich households, while enabling some of the poorer ones too. The extent to which transport investments bring economic benefits to a household depends on the assets the household can mobilize to take advantage of the improved opportunity". Additionally, the less productive among the local producers may suffer, since they will be exposed to competition from outside suppliers. However, even if the poorest may not travel or transport goods themselves, but they will nevertheless benefit from improved access to jobs, consumer goods, and inputs to whatever they are engaged in producing transport creates opportunities to increase the productivity of the poor (Duncan 2007, p7). Better rural roads are a necessary but not sufficient condition for graduating from poverty. There is little evidence that roads have impacted directly in terms of reducing income poverty on those groups in each study community who were identified explicitly as being very poor. The ability of the poor and very poor to make significant economic use of a road depends on their asset base and the entitlements to resources and opportunities that they can command, as well as on the passage of time.

Source: Hettige 2006

IMPACTS ON TRANSPORT SPEEDS, COSTS AND PATTERNS

Obviously, rural road improvements changed transport patterns of their users. The RAMP Project in Afghanistan USAID (2006) observed that farmers saved travel time, ranging from 0.51 minutes/km by taxi/car to 1.14 minutes/km by truck, depending on the condition of the roads before the rehabilitation. Substantial gains of up to 5 minutes/km were also made by non-motorized transport. The supply of transport had increased substantially, especially share-ride taxis and mini-buses offering frequent service, whereas in the past the only service was a rural bus offering one or two runs a day. Improved roads have also influenced the number of trips farmers make to markets and district centres. On average, farmers are able to make 5 per cent more trips per year if roads are open throughout the year and the transport service is more competitive. Vehicle operation costs have gone down by at least 16 per cent, thus benefiting both transport operators and farmers – the latter by way of reduced fares and rates. Survey data indicate that freight costs for transporting inputs and outputs between markets and villages has gone down by 10 per cent after rehabilitation of the roads.

Van de Walle (2002) states for Viet Nam that the "the road rehabilitation projects significantly increased the availability of freight services in the project communes, although they had no overall impact on passenger transport".

IMPROVED ACCESS TO HEALTH SERVICES AND EDUCATION

Starkey Hine (2014) state 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. Evidence from India, Nepal and other countries suggests that constructing and maintaining rural roads, paths and bridges leads to improved health outcomes and healthier rural communities (although there can be complex interactions and externalities that affect poor people).

Box 5: 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

Research in India (Banerjee et al 2015) shows, that the provision of roads increases the use of preventive health care by women and households. This is confirmed by an older research in India (Mohapatra 2007) where positive impacts were observed on accessibility to preventive and curative health care facilities; better management of infectious diseases, and attending to emergencies and increase in 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.

De Walle (2002) confirms similar findings through her research in Viet Nam: "The time needed to reach the closest hospital in case of a serious injury declined by an impressive three-quarter of an hour. There are positive (or non-negative) impacts on the availability of services in the project communes, In particular, increases in pharmacies, in the availability of credit from the Agricultural Bank of Viet Nam and in other government development projects were attributable to the road projects.

Starkey and Hine (2014) also regard access to education as follows: "Investment in rural roads, particularly to provide initial connectivity, leads to greater school enrolment (evidence from many countries including Bangladesh, Ethiopia, India, Morocco, Pakistan and Viet Nam). Investment in rural roads also leads to better staffing at village primary schools (evidence from India, Zambia and elsewhere)". Atsushi (2015) researched rural road improvements in Brazil and found "that improved rural roads changed people's transport modal choice. The paper also finds that the project increased school attendance, particularly for girls." Van de Walle (2009) confirms for rural roads in Viet Nam that "perhaps most notable, the project had significant, early and sustained impacts on primary school completion rates."

INVESTMENT IN FEEDER ROADS VS TRUNK ROADS

As mentioned there is debate 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. Trails and roads enable safer and faster access to markets and services." Evidence from Ethiopia, Ghana, Nepal, Uganda and elsewhere shows that upgrading footpaths to basic roads provides much greater benefits than upgrading existing rural roads to all-weather quality.

Government spending on rural roads in Uganda has had substantial impact on rural poverty reduction. 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 each 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 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.

Fan et al (2005), in an important study of the investments in roads in China, concluded that while China's huge investments in expressways was economically beneficial for China, the greatest returns to investments came from the construction of low-volume rural roads. The benefit/cost ratios

of ‘low quality’ (rural) roads were four times greater for national GDP than investments in ‘high-quality’ roads. Consequently, low-quality roads raise far more rural and urban poor above the poverty line per yuan invested than do high-quality roads. Therefore Banjo, Gordon and Riverson (2012) in their World Bank review of rural transport, emphasised the need to focus rural transport investments on the lower end of the rural road network—community roads, paths and trails—in order to meet the rural access and mobility needs of smallholder farmers.

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”. The only impact is an indirect one in the access to labour activities. The paper reasserts the fact that access to roads is only one factor contributing to poverty reduction. Considering that increase in non-farming activities is the main driver for poverty reduction in rural Africa, the results contribute to the idea that emphasis on road investments should be given to locations where non-farming activities could be developed.”

Qiaolun Ye (2006) undertook an extensive ex-post evaluation on the poverty impacts of the Southern Yunnan Road Development Project in China. The author presents findings that differentiate between areas with high development potentials and remote poor villages.

- In areas with “high potential for developing commercial crops, most households rose from poverty by growing these crops, which were promoted by commercial firms that signed contracts with farmers and purchased their production. In these areas, good roads were critical to attracting commercial firms to engage in contract farming.”

- In contrast, “upgrading isolated roads to poor, small villages located in remote and poorly endowed mountainous regions had a marginal impact on poverty reduction. Poor resource endowment and adverse farming conditions meant the poor in remote villages had little surplus to sell” Additionally, “the improved roads…did not mitigate lack of employment”.

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 favorable conditions, such as sufficient water, even if they are not poor”.

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. Rather, our findings suggest that it is necessary to improve the quality of roads such that they remain intact at all times, thereby ensuring constant and uninterrupted accessibility”.

GENDER ISSUES

Several authors mentioned positive impacts of rural roads on women with the key indicator being increased female visits of health centres. Cook (2005) ascertains that “women, particularly poor women are often at risk by the lack of or poor quality of transport services. 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.”

The positive impacts generated for women involved in road maintenance is mentioned by Qiaolun Ye (2006). There are also some experiences where women have formed successful cooperatives to maintain the roads, after receiving some basic training and some evidence that this has proved to be more reliable than if men organise this or if it is left to the district authorities.

Box 6: Gender and Development Cooperation Fund

The Gender and Development Cooperation Fund (GDCF) pilot demonstration project of the Asian Development Bank increased the funding for routine maintenance of rural roads in Dehong Prefecture, Yunnan Province, People's Republic of China making it possible to finance the remuneration of maintenance groups that work year-round to keep the roads open and to slow down road deterioration. This pilot project also provides a rare opportunity for off-farm employment especially for women and ethnic minority groups. Some 165 km of rural roads were successfully maintained by women's road maintenance groups resulting in continued access throughout the rainy season, as well as, improved road conditions, benefiting transport services and facilitating access to markets, schools, and health facilities. For the first time, the women were paid for their maintenance work and the flexible nature of the output-based payment system enabled them to easily combine this work with other household and farm responsibilities. Wages obtained from the maintenance work provided a major boost to household incomes, raising these beyond the official poverty line and providing the women with greater decision-making power in their households. The skills acquired to operate as maintenance groups and the quality of the maintenance work carried out, demonstrated the potential of ethnic minority women and their status within the community improved. They are now more easily able to participate in the management of public infrastructure. The pilot project has also improved gender awareness at different levels and has provided complementary training on economic activities with the aim of increasing the livelihood options for women. This approach to road maintenance by women's groups has the potential for wider replication in the People's Republic of China and in other developing countries.

http://www.adb.org/sites/default/files/publication/28945/manual-road-maintenance-womens-groups.pdf

Experience shows that engaging women as well as men in rural and urban transport planning and decision-making taps into their practical experience and often increases quality control and financial transparency (Making Transport Work for Women and Men, World Bank 2010)[5]. Women are also seen to have a higher motivation to ensure that access is maintained not only to ensure produce gets to market but also for children to attend schools, access to health care and opportunities to buy consumables.

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). Improved nutrition from a more varied diet engendered by new products brought in with better road connections can help them 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).

On the other hand there may be also less beneficial aspects that may occur with improved road access, which affect women more. Roads increase inwards and outward flows of goods and people and they may accelerate the depletion of 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. There is some evidence in Africa of increased numbers of female heads of households in rural areas as a consequence of (but not solely due to) this[6]. In nine countries, six in sub-Saharan Africa and three in Latin America and the Caribbean, at least one in five households is headed by a female and female headed households are most common in Ghana, Kenya and Namibia, where one-third of all households are headed by women[7]. It is also documented that women frequently do not have a 'voice' in many of the dimensions of development, despite being a head of household and may not be included in stakeholder discussions about access due to a variety of reasons. But once this occurs there is often value added to the project as seen from the Yunnan example (and others documented in the Making Transport Work for Men and Women report).

[5] http://documents.worldbank.org/curated/en/2010/01/16281335/making-transport-work-women-men-tools-task-teams
[6] UNFPA (2008) State of the World Population 2007: Unleashing the Potential of Urban Growth, p. 38.
[7] http://www.dhsprogram.com/pubs/pdf/CS21/03Chapter03.pdf based on Demographic and Health Surveys, 1990-1994

Increasing women's access to transport and markets not only increases their productivity but also the overall productivity of the household and community (UNFPA 2008)[i]. However there is still a paucity of research available to be able to establish if the impacts affected women more than men, and little disaggregated information is available, apart from the evaluation of pilot projects. More detailed work on the long-term benefits to women and deepening the knowledge of how improved access can affect women would be welcomed.

CONCLUSIONS

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.
- Other studies revealed that rural roads increased the revenues from non-farming activities. This implies a shift from subsistence agricultural 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. Thus, the very poor may not benefit from road improvements.

A number of authors argue that rural roads should be improved to the locations where poverty was most severe and the improved access to markets provide opportunities for subsistence farmers to integrate into the market economy and thus increase farm production, marketing and agricultural incomes. Many authors claim that upgrading of paths; tracks and feeder roads have a stronger effect on poverty than improving the main road network. The initial provision of access to markets has larger impacts since more income opportunities are generated than higher speeds and larger payloads on existing roads.

Other authors argued that rural roads should be primarily improved to locations where economic opportunities are best and thus induce a dynamic process for commercial farming and manufacturing, which again creates places of employment.

The approaches represent different views (and sometime political preferences). The first represents an approach to increase social equity, the latter represented a purely economic approach that intends to maximise the benefits generated per input unit. For example, China has decided to resettle inhabitants from remote mountain areas where income opportunities would remain low even with improved access. Voluntary resettlements to rural, compact, densely populated and well-endowed locations have been quite successful in reducing rural poverty. However, ultimately this may lead to unforeseen consequences and could increase uncontrolled migration into large cities.

Most of the studies are focussing on the effects of road investments, but do not take into account the life cycle aspect of the road. The sad truth in many developing countries is that roads are not adequately maintained and 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. Taking into account that the highest returns on road investments are achieved by road maintenance (40 per cent). followed by rehabilitation (20 per cent) and new construction (10 per cent) maintenance should be given a larger priority not only in research but also in operations.

The above observations are timely as 2016 sees a convergence of international agendas around sustainable development, climate change and Habitat III that can help governments to take action. There remain wide regional economic and social differences within countries and these continue to be important world-wide. Many include transport related targets and a number pertain to poverty reduction, rural access, increasing equity, women's empowerment and 'leaving no-one behind'. Yet these ambitions and the risks between dominant capital metropolitan regions and less well-funded rural areas, are usually constrained by poor road connections. From the current research it is not yet clear where it is best to make improvements and it is likely that as populations become

increasing urbanised, urban/rural tensions are likely to increase. Therefore it is recommended that greater attention and continued research is made to better understanding not only the direct transport impacts but also how to address poverty and equity with low carbon transport and increased connectivity.

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/Bär	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 Demo	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						

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