AFRICA INFRASTRUCTURE COUNTRY DIAGNOSTIC

Roads in Sub-Saharan Africa

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June 2008

About AICD

This study is part of the Africa Infrastructure Country Diagnostic (AICD), a project designed to expand the world's knowledge of physical infrastructure in Africa. AICD will provide a baseline against which future improvements in infrastructure services can be measured, making it possible to monitor the results achieved from donor support. It should also provide a more solid empirical foundation for prioritizing investments and designing policy reforms in the infrastructure sectors in Africa.

AICD will produce a series of reports (such as this one) that provide an overview of the status of public expenditure, investment needs, and sector performance in each of the main infrastructure sectors, including energy, information and communication technologies, irrigation, transport, and water and sanitation. The World Bank will publish a summary of AICD's findings in spring 2008. The underlying data will be made available to the public through an interactive Web site allowing users to download customized data reports and perform simple simulation exercises.

The first phase of AICD focuses on 24 countries that together account for 85 percent of the gross domestic product, population, and infrastructure aid flows of Sub-Saharan Africa. The countries are: Benin, Burkina Faso, Cape Verde, Cameroon, Chad, Congo (Democratic Republic of Congo), Côte d'Ivoire, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Uganda, and Zambia. Under a second phase of the project, coverage will be expanded to include additional countries.

AICD is being implemented by the World Bank on behalf of a steering committee that represents the African Union, the New Partnership for Africa's Development (NEPAD), Africa's regional economic communities, the African Development Bank, and major infrastructure donors. Financing for AICD is provided by a multi-donor trust fund to which the main contributors are the Department for International Development (United Kingdom), the Public Private Infrastructure Advisory Facility, Agence Française de Développement, and the European Commission. A group of distinguished peer reviewers from policy making and academic circles in Africa and beyond reviews all of the major outputs of the study, with a view to assuring the technical quality of the work.

This and other papers analyzing key infrastructure topics, as well as the underlying data sources described above, will be available for download from www.infrastructureafrica.org. Freestanding summaries are available in English and French.

Inquiries concerning the availability of datasets should be directed to vfoster@worldbank.org.

Summary

Viewed against the vastness of the subcontinent, the road network of Sub-Saharan Africa is sparse. Certainly, it is much less dense than the networks of other developing regions. But viewed against the region's population and income—and hence its ability to pay for maintenance—road density begins to look rather high. In several countries (Madagascar, Malawi, Mozambique, Niger), the asset value of the road network exceeds 30 percent of gross domestic product (GDP), an indication of the magnitude of the maintenance problem. Overall, road conditions already lag behind those found in other developing regions, although the network of main trunk roads has been maintained in reasonably good condition. [1]

The region's trunk network comprises a series of strategic trading corridors linking deep sea ports to the hinterlands of Africa. These corridors, which carry some US$200 billion in annual trade, are no more than 10,000 kilometers in length. The roads are generally in good condition, good enough to sustain speeds well in excess of the effective velocity of transit along these routes, which is rendered pitifully low (typically less than 10 kilometers per hour) by administrative bottlenecks at borders and ports.

The concept of an intraregional trunk network—the Trans-African Highway—has existed for some time, but owing to missing links and poor maintenance on key segments, its potential to connect the continent remains unrealized. To provide a meaningful level of continental connectivity, between 60,000 to 100,000 kilometers of regional roads are required.

The density of national primary and secondary road networks varies substantially across countries, but in many cases it already exceeds the length required to provide basic connectivity between primary and secondary cities and key ports and land border crossings.

Beyond the classified network of primary and secondary, there is a vast unclassified network of tracks providing varying degrees of service to rural areas. Fewer than 40 percent of rural Africans live within two kilometers of an all-season road—by far the lowest level of rural accessibility in the developing world. There is also evidence that physical isolation is preventing large areas of the continent from reaching their true agricultural potential. However, owing to low levels of population density, reaching a 100 percent target for rural accessibility would imply doubling or tripling the length of the existing classified network in most countries—a Herculean task.

With accelerating urbanization, Africa is also developing a substantial network of intra-urban roads. However, urban road density lags far behind what is found in other developing cities, particularly with respect to paved roads.

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[1] This note summarizes recent and ongoing research on transport investment in 24 African countries performed at the World Bank under the aegis of the Africa Infrastructure Country Diagnostic. The full report, with detailed country annexes and technical notes, is available at http://www.infrastructureafrica.org.

New institutions: road funds, road agencies, and toll-road concessions

The African roads sector has passed through a wide ranging and consistent set of policy reforms, with strong donor support. There is a relatively high degree of consensus about the direction of reform, with most countries embarked on very similar paths.

The initial thrust of the reform has been to create an *independent source of funding for road maintenance* based on road-user charges. The funds are fenced off from the general government budget and administered by an autonomous board. The great majority of countries surveyed already have established second-generation road funds, and most of the others are following suit. Only Nigeria and South Africa neither have a fund or a plan to create one.

Close scrutiny of the new generation of road funds reveals that not all of them correspond fully to the conceptual blueprint. Only 20 percent of the road funds studied in the sample (notably those in Kenya, Namibia and Tanzania) meet all seven criteria of good design specified by the 35-member Sub-Saharan Africa Transport Policy Program (figure A1). The criteria are a clear legal foundation, separation of functions, application of road-user charges, direct transfer of funds, representation of road users on the board, clear revenue allocation rules, and independent auditing of accounts.

Moreover, despite widespread application of fuel levies to fund road maintenance, the level of the fuel levy—and hence its utility—varies enormously across countries. The range extends from symbolic levels of around US$0.03 per liter, which are nowhere near high enough to make a material contribution to road maintenance, to around US$0.16 per liter, adequate to cover most maintenance needs. In addition, some countries have trouble collecting fuel levies owing to evasion (Tanzania) or delayed transfer of revenues (Rwanda). As a result they may capture as little as 50 percent of the anticipated resources. Because of lower-than-expected fuel levies, road funds in Benin, Côte d'Ivoire, Ethiopia, Gabon, and Zambia are dependent on budget allocations for more than 75 of their resources.

While 60 percent of road fund revenues are typically allocated to the main interurban road network, some countries have to varying degrees attempted to channel portions of the road fund toward the maintenance of rural and, to a lesser extent, urban road networks.

The second stage of the reform process has involved the creation of *road agencies*, independent from line ministries, with responsibility for contracting out public works. About two-thirds of the sample countries have already established a road agency, and others are in the process of doing so. Levels of autonomy vary from full responsibility for road network management to limited responsibility for the execution of road maintenance programs assigned by the roads department or ministry of roads. Only a third of these have private sector representation on their boards. Nigeria, Senegal, and South Africa have a road agency but not a road fund.

Road agencies have moved toward contracting out performance-based maintenance contracts—an important trend. The potential advantage of such contracts is that they provide a strong incentive for maintenance contractors to perform well, while reducing expenditure uncertainties for the road fund. In about half of the sample countries, more than 80 percent of maintenance work was contracted out. Use of this approach has been strongly, though not exclusively, associated with the presence of a road agency.
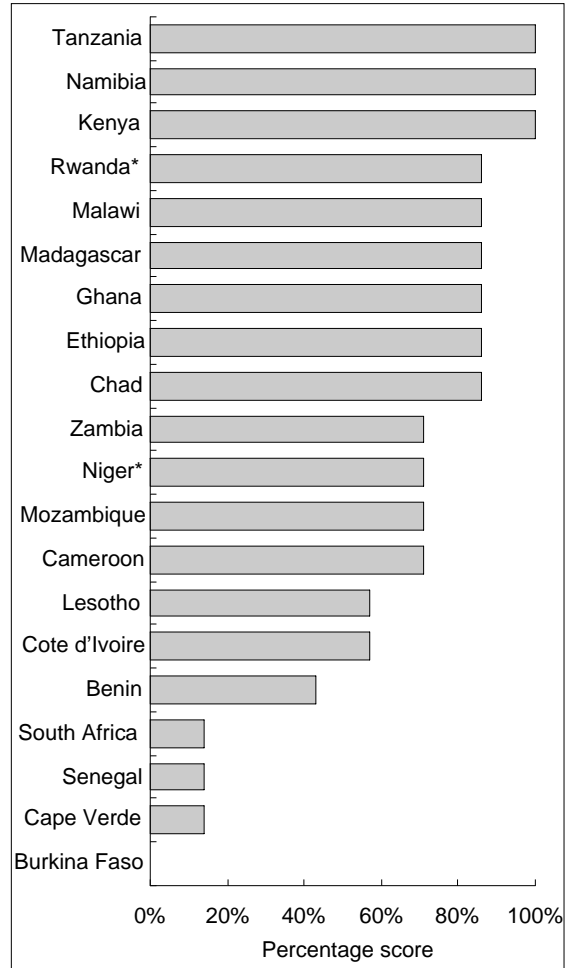
Improved contract management and disbursement arrangements of this kind have reduced the unit cost of road maintenance by 10 to 20 percent in Ethiopia, Ghana, and Zambia.

Figure A   Evaluation of road fund reforms

1. Prevalence of second-generation road fund characteristics
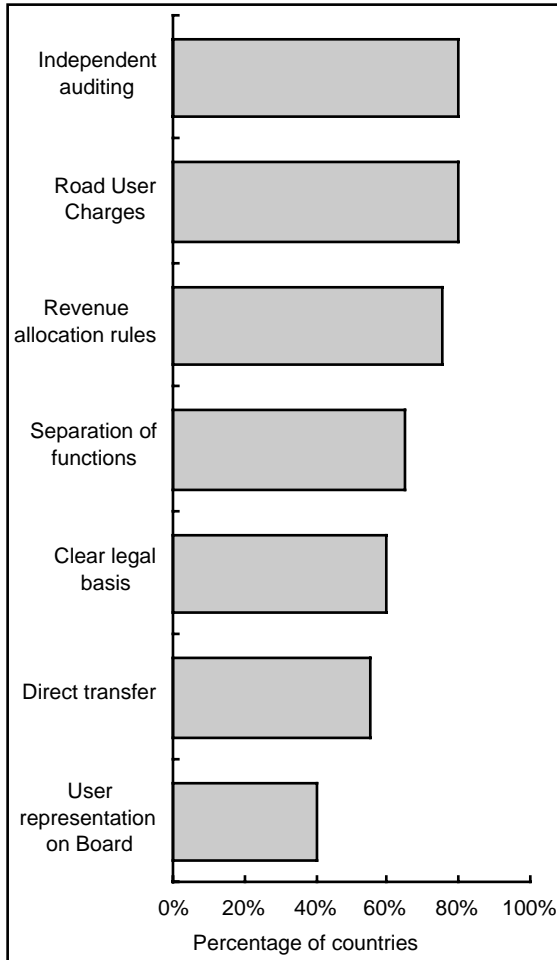
2. Scores on overall performance index

Source: SSATP RMI Matrix, 2007.

Toll-road concessions are rare, affecting barely 0.1 percent of the region's classified road network, almost all in South Africa. Concessions have captured no more than US$1.6 billion in investment commitments, paltry when compared to the region's overall needs. The limited prevalence of toll-road concessions reflects the fact that less than 10 percent of the region's road network attracts traffic volumes in excess of 10,000 vehicles per day, the minimum required to make concessions economically viable. Toll-road concessions hold additional potential in South Africa—and, to a lesser extent, in Nigeria—but the potential elsewhere in the region is extremely limited.

Spending: maintenance, rehabilitation, and new construction

Spending on roads in Sub-Saharan Africa averages just below 2 percent of GDP, with substantial variance across countries (figure B). This compares with the 1 percent of GDP that is typical in industrialized countries, and the 2–3 percent of GDP found in fast-growing emerging economies.

Although the level of effort is high relative to the size of Africa's economies, it remains little in absolute terms, with low-income countries spending an average of about US$7 per capita per year.

On average, countries spend US$9,000 per kilometer of the main road network. However, low-income countries spend 50 percent more per kilometer than do middle-income countries. Curiously, countries with road agencies and high fuel levies seem to spend somewhat less than those without.
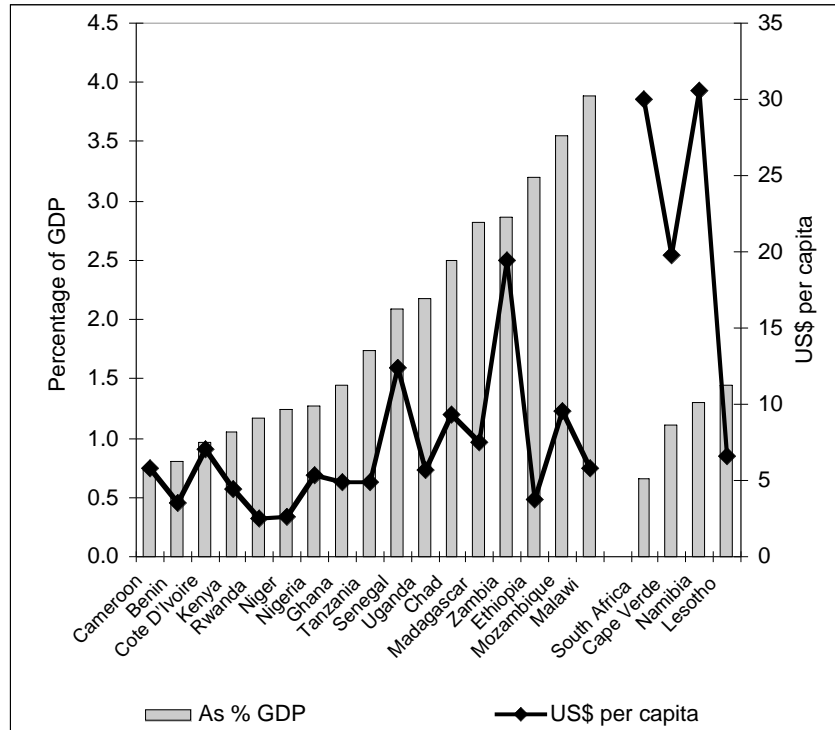
While road sector reforms have focused on maintenance, there is evidence of a persistent capital bias in spending. Investment accounts for two-thirds of total spending, leaving only one-third for maintenance. Based on practice elsewhere in the world, the balance between investment and maintenance should be closer to half and half.

Figure B   Average annual expenditures on road transport by country, 2001–05

Source: AICD, 2008

The capital bias is most pronounced in low-income countries, those with difficult geographical environments, and those without road funds or fuel levies, which may in part explain the higher levels of spending observed in these countries.

The bias would be even more pronounced if capital budgets were fully executed. On average, however, countries have budgeted 50 percent more on road investment than they actually succeed in spending during a given budget cycle. This represents an execution ratio of around 70 percent on average. Middle-income countries and those with established road funds and fuel levies fare substantially better than others in this respect. Deficiencies in planning and delays in procurement are the chief causes of this major problem.

High capital expenditure may be justified in some cases by large backlogs in rehabilitation projects in many sample countries. In fact, except in Chad and Ethiopia, current levels of capital spending either fall

well below what is needed to clear rehabilitation backlogs within a reasonable five-year period, or lie very close to that level (figure C).

The source of the funds spent on roads may also perpetuate the capital bias we have discerned. The limited evidence available indicates heavy dependence of road investment on official development assistance, ranging from just over 50 percent in Senegal to almost 90 percent in Rwanda. Donors have tended to favor dramatic new construction over mundane maintenance. Moreover, development assistance has proven to be quite volatile, contributing to the erratic pattern of public investment in the sector.

Figure C   Rehabilitation and maintenance spending relative to norms
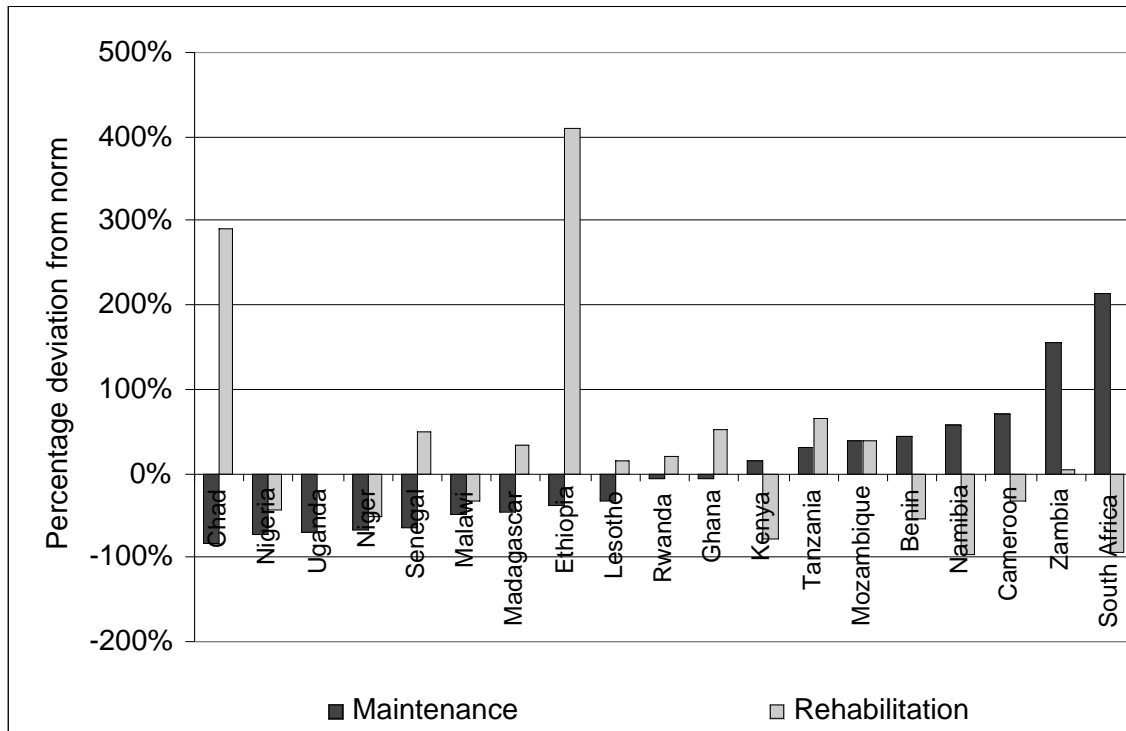
Source: AICD Fiscal Costs Study, 2008; AICD RONET Analysis, 2008.

Fully half of the countries surveyed are not devoting adequate resources to maintenance of the main road network, and about half of these are not even spending enough to meet routine maintenance requirements. In Chad, Niger, Nigeria, Senegal, and Uganda, maintenance spending is less than half the normative requirements.

There is great variation in spending for maintenance across countries, but underspending is conspicuous in low-income countries (particularly the resource-rich), whereas the few middle-income countries tend to spend substantially above the maintenance norm.

For the main road network, the maintenance range extends from barely US$200 per kilometer in Chad to more than US$6,000 per kilometer in Zambia. Maintenance spending per kilometer of the main network tends to be about double that of the rural networks, which consistently get short shrift, even where maintenance is adequate on the main roads. On the whole, there is an inverse relationship between the level of maintenance expenditure in a country and the level of capital expenditure in the same country.

Countries with a road fund and higher fuel levies devote a greater share of their spending to maintenance and fall closer to normative levels of spending. **[[can this be easily illustrated?]]** Among countries with fuel levies, those with high levies do substantially better than those with low fuel levies. Notwithstanding the shortfalls in road fund resources noted above, there is evidence that road funds have reduced the volatility of sector spending relative to traditional budget allocations.

The results presented here are premised on unit costs that have been observed in the recent past, which are fairly consistent between Sub-Saharan Africa and other developing regions. However, it is known that unit costs for roads have recently undergone a significant escalation, which threatens to further dilute the adequacy of current budget allocations. The escalation can be attributed to a lack of competition and to increases in the prices of road-construction inputs, most traceable to the recent escalation in the oil price.

With road costs rising, it is more important than ever that engineering standards should be cost-effective. Network analysis reveals that on average around 30 percent of main road networks are overengineered relative to observed traffic volumes, while only 10 percent of main road projects (and 15 percent of rural projects) are underengineered. The failure to follow appropriate engineering standards suggests that resources have been wasted, but it also points to the way to cost savings in the future.

Greater efforts are also needed to adapt road design standards to local conditions and materials so as to avoid excessive costs in road construction. Particularly urgent is the development of an appropriate standard for low-volume sealed roads.

Road quality: surface and condition

The countries surveyed vary widely in the share of main roads in good condition, but less so in the share in good or fair condition (figure D). On average, about half of the main network is in good condition and a further third in fair condition. The same cannot be said for the rural network. In the countryside, only about a quarter of the road network is in good condition and a further quarter in fair condition. Things may be improving, however. The limited time series evidence available suggests that most countries have achieved improvements in road quality in recent years.

Notwithstanding substantial variation in the percentage of roads in good condition, there is surprisingly little variation in the asset value of road networks as a percentage of its *potential maximum* were it all to be in good condition. All countries realize at least 70 percent of this potential asset value, suggesting they have concentrated their efforts on preserving the high-value paved road network.

Policy variables also turn out to have a material effect on road network performance. Countries with *both* road funds and road agencies show substantially higher levels of road quality than those that lack either one of these institutions. Furthermore, both the design of the road fund (whether it meets the SSATP criteria) and the amount of the fuel levy reliably predict the quality of the main road network but not of the rural network.

Countries that devote a larger share of their road funds to maintenance (and that also have road agencies) show significantly better quality indicators for their main road network; though, once again, no such clear relationship is found for rural roads.

Figure D   Good, fair, poor: road network length by country, class, and condition

(a) Main network   (b) Rural network
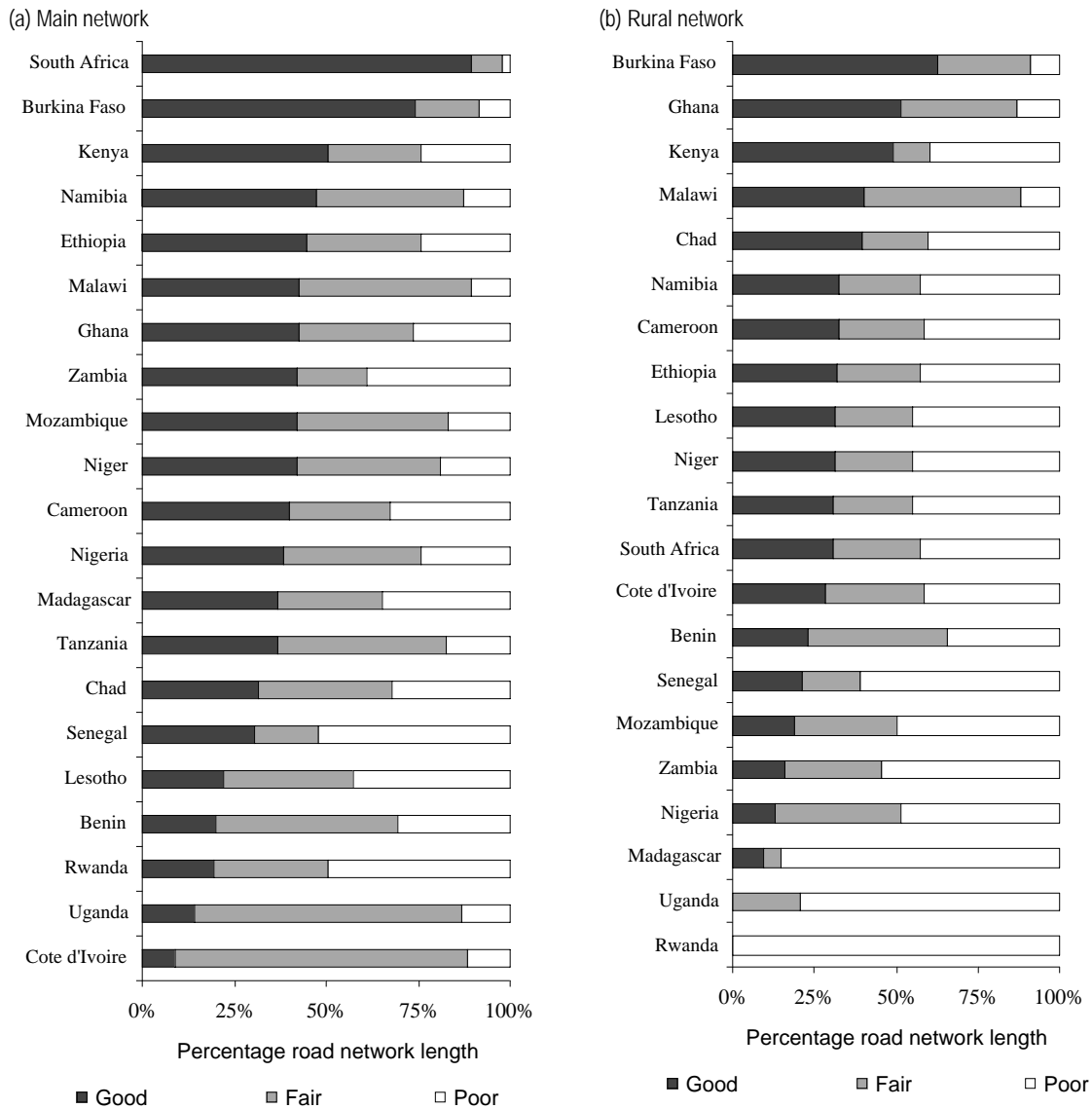
Source: SSATP RMI Matrix, 2007; AICD RONET Database, 2008

Putting it all together: institutions, expenditures, and quality

According to their performance on the three variables—institutions, expenditures, and network quality—the countries can be divided into four groups. South Africa and Namibia stand out as being the strongest performers overall. Prominent in the second tier are Ethiopia, Ghana, Kenya, Mozambique, Nigeria, and Tanzania. The third tier includes Benin, Cameroon, Chad, Madagascar, and Zambia. The final tier comprises countries such as Lesotho, Rwanda, and Senegal. In each tier, it is possible to observe countries that are further ahead in institutional development or maintenance expenditure.

Variations in road quality across countries reflect both fundamental economic and geographic conditions, as well as the influence of institutional design and financing flows. GDP per capita is the factor most strongly correlated with the percentage of the main road network in good condition, reflecting effort devoted to the paved roads in the network. Climate and terrain, on the other hand, are the factors that best predict the percentage of the main and rural network in poor condition, because difficult climate and terrain speed the rate of deterioration. But economic and geographic idiosyncrasies do not explain all of the variation in road quality across countries. Even controlling for income and climate, substantial variation can be seen in road quality across countries.

Important lessons emerge from this analysis. Notwithstanding their limitations, institutional reforms have had a discernible impact on outcomes. Countries with well-financed road funds do significantly better at capturing resources for maintenance. Countries with road funds *and* road agencies do significantly better at converting resources into road quality.

But the advance of institutional reforms—though impressive—is incomplete in many cases. To be effective, the establishment of a road fund must be accompanied by a fuel levy set at a realistic level and adequately collected.

Finally, the choice of road surface type needs to be more carefully informed by analysis of traffic volumes. Funds wasted on overengineered roads could be better used for other purposes, notably maintenance and the extension and improvement of rural road networks.