decades; and (ii) the substantial donor assistance its road sector has received - about US$ 830 million, under the first phase (1990-95) of the Integrated Road Project - and is due to receive even more (US$ 650 million committed to date) under the second phase. The Integrated Road Project is focused on the trunk and regional road network of about 25,000 km. There are also district and feeder road networks comprising another 26,000 and 22,000 km respectively. These are the ‘rural roads’ that provide local access and are of most concern to the majority of the population. It is with them and their equivalent in other African countries that this paper is concerned.

The factors underlying the poor condition of Africa’s road networks would be less depressing if it were new but this is not so. The fundamental issues were identified in 1979 (World Bank, 1981). But despite almost two decades of effort, until recently progress has been patchy. Since it was initiated in 1989 the World Bank and UN Economic Commission for Africa’s Road Maintenance Initiative has made progress in defining a framework for reform which gives primary emphasis to the commercial management and financing of road systems (Heggie and Vickers, 1998). Commercialisation is based on four interdependent building blocks of reform:

- Involving road users so that they can take part in decisions on levels of service and charges;
- Stabilising road financing by a mechanism to ensure an adequate, steady flow of funds;
- Clarifying responsibility in the area of network management; and
- Improving the management and efficiency of the bodies in charge of road maintenance.

These ideas are in various stages of implementation in about a dozen countries and the progress made by the best performers gives grounds for guarded optimism. However, the immensity of the reforms is such that for the next decade main roads are likely to be the

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**Abstract**

Many rural roads in Africa are ‘returning to the bush’ because of inadequate maintenance. This is not helped by development loans which encourage construction of new roads and rehabilitation of existing infrastructure rather than better value ongoing maintenance. Much of the problem lies in the technical arguments put to decision makers. Here we see the argument put in a way that non-technical people can understand.

**Keywords**

Africa, investment, Kibaale District, maintenance, rural roads, revenue

**Road conditions**

Africa’s roads were in bad shape before the El Niño storms in the spring of 1998 added selectively to the damage. Road condition surveys for the World Bank in more than 30 countries in East and West Africa revealed a picture of severely deteriorated - and deteriorating - networks from which not even the main highways have been spared (Sylte 1996, 1997). A May 1998 journey in Tanzania between its major port and commercial centre, Dar es Salaam, and the capital Dodoma showed that the condition of sections of the highway reduced traffic to a crawl while large potholes were laboriously negotiated. Newspaper reports indicated that large areas of the northwest of the country were not reachable by road other than through Kenya and Uganda, a detour of several hundred kilometres. Off the main roads conditions were far worse with the majority in poor condition and a significant proportion unusable by normal vehicles. (Technically a road is said to be in a poor condition if is not in a maintainable state and requires rehabilitation before maintenance operations can be re-instated.)

Tanzania’s situation is particularly revealing because of: (i) the relative stability of its political climate over the past four decades; and (ii) the substantial donor assistance its road sector has received - about US$ 830 million, under the first phase (1990-95) of the Integrated Road Project - and is due to receive even more (US$ 650 million committed to date) under the second phase. The Integrated Road Project is focused on the trunk and regional road network of about 25,000 km. There are also district and feeder road networks comprising another 26,000 and 22,000 km respectively. These are the ‘rural roads’ that provide local access and are of most concern to the majority of the population. It is with them and their equivalent in other African countries that this paper is concerned.

The factors underlying the poor condition of Africa’s road networks would be less depressing if it were new but this is not so. The fundamental issues were identified in 1979 (World Bank, 1981). But despite almost two decades of effort, until recently progress has been patchy. Since it was initiated in 1989 the World Bank and UN Economic Commission for Africa’s Road Maintenance Initiative has made progress in defining a framework for reform which gives primary emphasis to the commercial management and financing of road systems (Heggie and Vickers, 1998). Commercialisation is based on four interdependent building blocks of reform:

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These ideas are in various stages of implementation in about a dozen countries and the progress made by the best performers gives grounds for guarded optimism. However, the immensity of the reforms is such that for the next decade main roads are likely to be the
principal beneficiaries. Rural road networks will receive little benefit because there are political limitations to the rate at which road user charges and fuel prices may be increased without risking civil unrest, (which can be extreme). This is especially likely when the populace has become accustomed to very low real costs, a lesson that countries as culturally diverse as Indonesia, Nigeria and Venezuela have learned to their peril. Thus, funding the maintenance, yet alone development, of entire road networks out of locally generated funds remains a distant prospect in most countries. The main highways will necessarily come first.

For the rural road networks there are additional difficulties. First, they are normally managed by local government administrations whose weak financial, institutional and human resource base renders the sustainability of all public investments immensely difficult. Second, local administrations also feel the full effect of a number of fundamental characteristics that inhibit Africa’s development. Geography, population dynamics and neglect of the financial realities necessary to sustain its road networks stand out as being crucial to its predicament.

Geography and population dynamics
The sheer size of Africa has been systematically misrepresented ever since Mercator drew his famous map of the world. Few people realise that you can put Argentina, China, Europe, India, New Zealand and the USA inside Africa and still have space left. (The total area of these countries amounts to 30,245,000 km² whereas Africa’s area is estimated at 30,345,000 km².) This huge area contains a comparatively small, impoverished population that is, moreover, very unevenly distributed. Thus whilst there are areas where the population is densely concentrated - Rwanda, Burundi, and the major volcanic mountains of East Africa are examples - its density is about 20 persons per km² averaged over the continent compared to six times this figure in most of Asia.

The sparseness and poverty of its population means that it is inherently difficult to support the maintenance of all types of infrastructure. There are vast distances with very few people to generate the revenues necessary to sustain maintenance. Without maintenance even bitumen surfaced roads will become unusable in as little as 10-12 years; with gravel roads it is normally of the order of 6-8 years; and for earth surfaced roads as little as 3-5 years, depending on climate. Rural road networks are confronted by a special difficulty - many carry very little traffic, albeit that these modest vehicle flows may be vital to sustain local communities.

There seems to have been a reluctance among all concerned to confront the unfortunate issue of the very low demands in many areas. Construction is the easy part as there is a never-ending stream of donors willing to finance capital investment. But roads incur recurrent costs if their initial effects are to be sustained into the creation of long-term impacts, and these are high measured against locally generated budgets.

Financial realities
The financial realities of sustaining road networks can best be illustrated by some simple calculations, albeit based on realistic estimated values. Under African conditions 1 km of rural road might have an influence area of 10 km² (5 km either side), or influence population of 200, some 30 households. Since the annualised cost of maintenance per km is of the order of $500 for an earth and $1500 for a gravel road the yearly cost per household ($17 - 50) is significant. This is because although the notional GNP per capita per year for Sub-Saharan Africa is some $540, actual cash income for many rural households living at subsistence level is likely to be of the order of perhaps $100 or less per annum. Even if it were possible to tax such households efficiently, something which has defeated generations of administrators and is not even feasible in the much more controlled urban areas, any realistic taxation rate would evidently still not yield sufficient revenue to pay for road maintenance.

The constraint imposed by financial realities is not one which has been heeded by its politicians and the length of road systems has expanded substantially even during the so-called ‘lost decade’ of the 1980s and the depressed 1990s. Tanzania again provides a reasonably typical example. The aggregate length of its trunk, main and district road categories more than doubled from around 24,000 km in 1972 to some 51,000 km in 1997 (Andreski and Malisa, 1998). Continentally the UN Economic Commission for Africa remains committed to the notion of Trans African Highway networks (Figure 1) with the Southern terminus presumably in Cape Town, although the additional route length does not represent new construction since South Africa already possesses an excellent highway system and, in this respect, is an exception.
The scale and intractability of Sub-Saharan Africa’s road network problem prompts the question: ‘does it have too many roads?’ This has already been alleged by the World Bank, but only in a qualitative rather than quantified way: ‘while Africa is under-equipped in relation to its potential it is overburdened by the little infrastructure it possesses’ (Riverson, et al. 1991). The 1994 World Development report offered further quantified support to this notion (World Bank, 1994). It shows (Figure 1.2, page 16) a correlation for all developing countries of paved roads per million population against notional GNP per capita in Purchasing Power Parity dollars. It is notable that the majority of the African countries are well above the trend line. A similar conclusion can be drawn from the road condition surveys referred to previously, which reveal that most countries are able to finance no more than 25-30% of their nominal maintenance requirements. Even these proportions are over-estimates since much is spent on the wages of over-staffed public works departments rather than productive work.

Lack of finance will result in attrition of the network and has already done so, although not in any strongly rational way since political instinct is to spread available money as thinly as possible over the entire network so as to benefit the maximum number of people. While this is understandable it does not necessarily constitute the best use of these resources. In most countries some degree of network reduction is likely to be necessary, albeit that it will be fiercely resisted. It will happen anyway due to attrition - the choice is to manage the process in some rational way or have it occur haphazardly.

What needs to be done?
Recent surveys in four African countries (Ethiopia, Lesotho, Tanzania and Uganda) indicate that - over and above other resource problems - finance is the binding constraint on rural road network sustainability (Howe et al., 1998). However, international experience suggests that the problem lies as much with the misallocation of financial resources as with their absence – specifically a destructive emphasis on construction to the almost complete neglect of maintenance. It is notable that in most of the study countries road investment has been for rehabilitation rather than the opening-up of completely new routes. The very notion of ‘rehabilitation’ is indicative of a failed maintenance policy, i.e. the construct-lack of maintenance-deteriorate cycle has been gone through at least once. This raises the question: ‘why it is so difficult
Managing rural road networks using the asset value approach

The previous situation, which is common in many countries, has led to proposals for road network management strategies based on a concept which is readily understandable by a wide range of decision makers at all levels in the administrative hierarchy. Conservation of the inherent asset value of the network expressed in money terms. (The notion of asset-based management has arisen from the joint work of the World Bank and GTZ under the Road Maintenance Initiative and is practised by other utilities such as the water sector and Metropolitan Boroughs in the UK – see Metschies, 1998, Banyard and Bostock, 1998.)

The basic idea is very simple …

• The current asset value of any road network can be estimated in monetary terms with reasonable accuracy at a particular point in time, in the same manner as the balance sheet of a company.

• Lack of maintenance will result in the deterioration of the network by physical attrition due to the effects of climate and traffic, which implies a continuous decrease in its asset value. Earth and many lightly gravelled roads will deteriorate to a point that they are unusable, except with great difficulty, in as little as 3-5 years depending on location. This is a matter of common experience so it is easy to reach agreement on what sort of interval should be assumed for estimation purposes.

• While investment in the rehabilitation of currently unusable routes or the addition of completely new roads implies an increase in the asset value of the network, this may, and is indeed likely to, be more than counterbalanced by the losses incurred from non-maintenance of existing maintainable routes.

• Thus the wisdom of any investment programme and crucially the balance

### Table 1: Financing of rural road maintenance – the Rwandan case

<table>
<thead>
<tr>
<th>Road Surface</th>
<th>Length km</th>
<th>Asset Replacement Value per km</th>
<th>Total Asset Value per km million $</th>
<th>Total Network Value % of Asset Value</th>
<th>Annual Maintenance Requirement % of Asset Value</th>
<th>Yearly Expenditure per km $</th>
<th>Rule of Thumb for National Road Maintenance Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td>900</td>
<td>7.3</td>
<td>400,000</td>
<td>360</td>
<td>1.5</td>
<td>6,000</td>
<td>5.40</td>
</tr>
<tr>
<td>Gravel</td>
<td>2,500</td>
<td>20.2</td>
<td>50,000</td>
<td>125</td>
<td>3.0</td>
<td>1,500</td>
<td>3.75</td>
</tr>
<tr>
<td>Earth</td>
<td>8,500</td>
<td>68.5</td>
<td>10,000</td>
<td>85</td>
<td>5.0</td>
<td>500</td>
<td>4.25</td>
</tr>
<tr>
<td>Urban Road</td>
<td>500</td>
<td>4.0</td>
<td>80,000</td>
<td>40</td>
<td>4.0</td>
<td>3,200</td>
<td>1.60</td>
</tr>
<tr>
<td>Total</td>
<td>12,400</td>
<td>100.0</td>
<td>-</td>
<td>610†</td>
<td>2.5</td>
<td>15.00</td>
<td>100</td>
</tr>
</tbody>
</table>

**Notes**

1 Costs comprise labour intensive routine recurrent maintenance and periodic maintenance. Maintenance for asphalted roads (resealing) is needed every 8 years and for gravel roads (rebuilding) is needed every 5 years, except with great difficulty, in as little as 3-5 years depending on location.

2 This table is without backlog requirements of previous years and without new construction or rehabilitation.

3 Empirical assumptions according to road surface classes.

4 The value of 1 km of asphalt road (2 cm double surface dressing) is $400,000.

5 More than 2/3 of the network is rural roads (earth roads).

6 According to the length of a human: 2 men for 3 km ($1 per working day + equipment + supervision).

7 The total Asset Replacement Value of 610 million US$ is equivalent to 41% of the Gross National Product of the country.

8 The total expenditure needs of $15 million may also be obtained by generally applying 2.5% to the Asset Value of $610 million of the total network.
between capital and recurrent expenditure can be judged on whether or not it increases the net asset value of the network. Programmes, which result in a decrease in the asset value, simply cannot be regarded as developmental. Such would be the likely consequence of an over-emphasis on investment in construction relative to that in maintenance.

- Since the calculation of the outcome of various investment options is straightforward and only in money terms, then they could be carried out in a participatory manner so that local decision makers could determine for themselves the financial consequences of their own proposed actions.

Box 1: Comparing asset values
Case 1

Nil Maintenance:

Year 1 Asset balance

Asset value of road in maintainable condition 250 km @ US$ 10,000 = US$ 2,500,000
Asset value of non-maintainable road 220 km @ US$ 10,000 x 0.4 = US$ 1,000,000
Total asset value = US$ 3,500,000

Annual maintenance cost for a stable network is @ 5% of the asset value of those in a maintainable condition = US$ 125,000. If this were spent on maintenance then the network would have the same asset value in Year 3.

Assume that the cost of rehabilitating other roads in a non-maintainable condition is US$ 6000 per km, based on experience in Kibaale District, and that for three years the nominal maintenance money is spent for this purpose instead of maintenance. Then 3 x US$ 125,000 / 6000 km can be rehabilitated = 62.5 km.

The expected asset balance will then be as follows.

Year 3

Reduced asset value due to nil maintenance of roads in a maintainable condition in Year 1 250 km @ US$ 10,000 x 0.4 = US$ 1,000,000
Asset value of non-maintainable road (220 - 62.5 km) @ US$ 10,000 x 0.4 = US$ 630,000
Asset value of 62.5 km of rehabilitated road @ 6000 = US$ 375,000

Total asset value = US$ 2,005,000

Net asset loss Year 1-3 = US$ - 1,495,000

It would be difficult to argue that such an investment balance is developmental and yet this approximates to what many countries are actually doing.

Case 2

Assume roads are partly gravelled so they could justifiably be considered to have a higher asset value of, say, US$ 30,000 with an annual maintenance estimated at 4% of this sum. With nil maintenance we assume that the roads will deteriorate to 40% of their nominal asset value (i.e. to an impassable condition) over a 5 year period. Using a similar logic as for Case 1 it can be shown that:

Net asset loss Year 1-5 = US$ - 4,000,000

In essence such an approach is likely to require giving first funding priority to the regular routine maintenance of all roads in a maintainable condition and only undertaking further investment in rehabilitation once this objective has been satisfactorily secured.

The data in Table 1 will be used to illustrate the principles of the asset value approach using supplementary data from Kibaale District, Uganda. This is for illustrative purposes only, but does impart a degree of realism to the calculations. The table is a simplified version of an original based on Rwanda, which incorporated the notion of a Road Fund so as to determine appropriate fuel taxation levels, and gives figures for an entire national road network. However, the principle can easily be adapted to a typical rural district (Metschies, 1998). In this respect the most important figures are those which indicate asset values and maintenance requirements for gravel and earth roads in columns (3) and (6), respectively. Asset replacement values are estimated at US$ 50,000 and US$ 10,000 per km, and annual maintenance requirements at 3% and 5% of these figures, respectively.

Kibaale District Road Network

Kibaale District is thought to have a nominal feeder road network of about 470 km. Allocation into gravel and earth roads is more problematic since due to the prevailing lack of maintenance and climate-induced deterioration, conditions change substantially within 2-3 years. Present informed opinion is that some 250 km of the network is in a maintainable condition, with the remaining 220 km having ‘returned to the bush’ due to lack of maintenance.

Core Assumptions

In the first scenario (Case 1) roads in a maintainable condition will be treated as having an earth surface with an asset value of US$ 10,000 per km and annual maintenance at 5% of its asset value. With nil maintenance we assume that the roads will deteriorate to 40% of their nominal asset value (i.e. to an impassable condition) over a 3-year period. The roads that have ‘returned to the bush’ may be unusable, but they still have a residual asset value since the right-of-way is usually preserved, albeit overgrown, along with some earthworks, drainage and possibly structures. These roads are valued at 40% of their asset value and are assumed to have a zero annual maintenance cost. We can now examine in Box 1 the asset balance after three years as a result of different investment strategies.
Howe: Sustaining Africa’s rural road networks: The asset management approach

World Transport Policy & Practice 5/1 [1999] 11 - 16

Conclusion

These examples are simplistic, but all of the assumptions are close to real values. Moreover: (i) they represent what has actually been happening in many rural areas and illustrate why the rehabilitate-inadequate maintenance-deteriorate cycle is so economically wasteful; and (ii) the assumptions can easily be changed until a consensus is reached that they reflect local experiences and values.

It is then possible to vary the rehabilitation maintenance expenditure ratios over a range of values to reflect various options and for the decision-makers themselves to determine what happens to the net asset value of the network as a result. Since the calculations are no more than simple arithmetic non-technical people can readily understand them. It seems likely that most will also agree that investment policy is not really serving a development purpose if as a result the asset value is actually decreasing.

References


