ANGOLA ROAD SECTOR PUBLIC EXPENDITURE REVIEW

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EXECUTIVE SUMMARY

Angola has made an unprecedented effort to salvage its infrastructure that was devasted during the 27-year civil war (1975-2002). By the end of the civil war in 2002, the Government of Angola has launched a large infrastructure reconstruction program by allocating on average US$4.4 billion per year between 2002-2009. This effort was sustained over the last decade (2008 -2018) and Angola spent on average an additional 4.1% of its GDP per year. Angola's infrastructure public expenditure is on a par with the average expenditure of Lower and Medium Income Countries (4.0% of GDP for 2011) and is nearly twice more than Sub-Saharan African countries (2.5% of GDP).

Most of the public expenditure on infrastructure was in the transport sector of which more than two-thirds was spent on roads. Angola has made significant effort to rebuild its dilapidated road network during the first post-civil war years and has spent on average US$2.8 billion/year in road re-opening programs (2002-2009). This effort was pursued over the 2008-2018 period and around US$2.1 billion/year or 2.1% of Angola's GDP was allocated to the road sector. The quasi-totality (97%) of the public expenditure in the road sector was allocated to capital expenditure, consisting mainly of rehabilitation and repaving works. The share of road maintenance expenditure was, on average, only 3.5% of the total expenditure on roads, or $US28.0 million/year.

Had the resources been spent efficiently, Angola could have built three times more kilometers of national roads and doubled the length of its current municipal road network. Real increases in spending have not been accompanied by commensurate increases in physical road output and quality. During the period (2008-2017), central government has spent a total of around US$20.64 billion on the national road network (fundamental and complementary roads), or around US$2.52 million/km. This is a very high unit cost compared to the unit cost to build a new two-lane road which, on the high range, is estimated to be around 0.8-1.0 million/km. Considering the total amount of road sector expenditure during this same period, Angola could have added a total of around 25,795 km of new roads to its national network, three times more than the actual road length of 8200km reported by INAE and MINCON. During the 2008-2017 period, around 17.5 billion Kwanzas/year, on average, were spent on provincial/tertiary roads (or an equivalent of US$171 million/year). However, the sub-national road network is still in a critical condition and shrinking in size. Angola could have added a total of around 34,000 km of new sub-national roads or doubled the current size of its municipal road network.

The shift from road development to road maintenance has not occurred during the last decade. The quasi-totality (97%) of the public expenditure on the road sector was allocated to capital expenditure during the 2008-2018 period. During this period, the share of road maintenance expenditure was on average 3.5% of the total expenditure on roads, or $US28.0 million on average per year over the same period (Figure 10 and 11). There was a sharp increase in the share of road maintenance expenditure (25%) in 2015 which could be explained by the creation of the road fund (2015) but hardly any road maintenance expenditure was undertaken during the last three years (2015-2018). Oil revenues have taken a sharp decline during this same period and road maintenance has subsequently not become a priority.

The impact of recent investment levels is minor and can be seen in the poor-quality of infrastructure in Angola. Around two-thirds (64%) of the total rod network is in poor or critical condition. Angola's quality of road infrastructure is ranked 136th out of 141 countries, based on the 2019 Global Competitiveness

Report. Angola's score is 2.2 out of 7.0 and is one of the lowest in the Africa region. Angola is lagging behind countries with the same GDP/capita along with many countries with lower GDP/cap (i.e. Ghana, Senegal, Cote d'Ivoire). Angola ranks 159 out of 160 countries in the 2018 Logistics Performance Index (LPI) and 153 out of 160 in the Infrastructure Performance as part of the LPI. This low quality of infrastructure is one factor constraining further improvements in Angola's competitiveness ranking.

The current road network asset value is around US$11.250 billion or around 11.0% of Angola's GDP and every US dollar spent on road maintenance will generate US$3.4 in road user cost saving. The current asset value as a share of maximum road asset value is 74.5%. This indicates that more than 25% of the road network asset value is lost due to lack of maintenance or deferred road rehabilitation work. Over the next five years, a total of US$ 924.8 million per year is needed for rehabilitation (US$613.2m), periodic maintenance (US$241.2m) and routine maintenance (US$70.4m) of the total network, of which US$771.4 m or 83.4% should go to the national roads (Fundamental and complementary roads) and the remaining US$153.4m or 16.6% to the sub-national roads (unclassified/municipal roads). In years six to twenty, once this initial rehabilitation backlog program is completed, US$320.4 million per year will be needed for preservation works of the entire network of which around 90% should be spent on routine and periodic maintenance work. The annual net present value of road agency costs over the 20-year evaluation period, at 6% discount rate, is US$660.8 million/year. This also indicates that every US dollar spent on road maintenance will generate US$3.4 in road user cost saving.

Angola's current average annual road sector expenditure (US$2,231 billion) is nearly two and a half times (2.4 time) more than road rehabilitation and maintenance requirements (US$0.925 billion). The estimated annual cost to properly rehabilitate and maintain the national roads (US$771.4 million) is 2.67 less than the current average annual expenditure (US$2.06 billion) on national roads (2008-2017). As for the sub-national roads, an estimate of 153.4 million per year is needed to rehabilitate and maintain the municipal road network (33000km). This is less than the current average of US$171.0 million spent each year through sub-national government on municipal roads. The average annual expenditure exceeds by 11% the road rehabilitation and maintenance requirements.

There is a need to invest in rural road development programs. Half of the population is located further than 2km from any road. Access to social services (health centers and schools) is poor overall, only 37% of the total population can access hospitals and schools in less than two hours. Access of agriculture production to main markets is limited, almost three quarter of the total agriculture production value cannot reach markets, although this varies across provinces. This indicates that there is a need to invest in road development programs to fill the rural road accessibility gap in the eastern, northern and southern provinces of the country.

There is a need to improve the governance and accountability of the road sector. The level of spending on national roads (fundamental and complementary roads) is nearly two and a half times (2.4 time) more than the estimated road rehabilitation and maintenance requirements. This increase in spending has not been accompanied by commensurate increases in physical road output and condition. This has resulted in much higher average costs for both preservation and development works. This cannot be explained only by a lack of technical and management capacity but is clearly due to poor road sector governance. The current institutional set up of the road sector allows for the separation of policy, management and financing (Road Fund, 2015) functions however this does not seem to be implemented effectively. Addressing these issues will be necessary to gain efficiencies and cost reductions that can be

passed on to road users. There is a need to introduce more efficient and business-oriented road management practices and to improve financial and managerial accountability. A set of measures could be taken including (i) improving the road fund effectiveness to fully play its role of mobilizing adequate revenues to cover road maintenance needs and to make sure the resources are used in efficient way. (ii) Consider the creation of road management agencies at provincial level to increase sub-national public expenditure effectiveness and efficiency and to address the low technical and managerial capacity issue. (iii) Develop and sustain a road data base and asset management system and review the road network classification to assert the ownership of the complementary roads (the missing middle) and the unclassified roads (Municipal roads); and (iv) support the development of a competitive road contractors' industry. Chapter 6 discusses the recommendations of this public expenditure review and a summary is presented in the table below.

Rationale/challenge	Remedial measure/action	Responsible Institutions
Road Financing: -Current spending is general budget based, erratic and half of the road maintenance needs - Road maintenance programs are not developed on technical and economic sound basis; - Quality of road maintenance work is below standard - Current Road Fund is established on strong legal basis and its revenue based on road user charges but there are no clear implementing regulations; Current Road Fund staff size is higher than the recommended average number of twelve staff.	-Issue implementing regulations enabling the Road Fund to fully play its role of mobilizing sustainable road maintenance financing -Road Fund to validate road maintenance programs submitted by INAE on technical and economic sound basis; -Road Fund to carry out independent financial and technical audits of road maintenance work programs -Issue implementing regulations to mobilize and transfer road user charge-based revenue to the Road Fund (fuel levy, vehicle license fee, transit fee…); -The procurement of road maintenance work function is no longer within the RF mandate – RF should operate based on a lean management organization consisting mainly of technical staff.	RF MINCON MINFIN
Road Management: -Description of the road network is scarce and unreliable	-Create a road data base entity within the INAE road planning/maintenance division and allocate adequate budget to carry out regular road inventory, condition and traffic surveys	INAE MINCON

-INAE has no website, has no road inventory database and does not carry out road condition and traffic surveys; -No budget allocations to cover the cost of road inventory and traffic surveys; -No technical capacity to develop and maintain a road asset management system.	-Develop a road database website and Geographic Information System -Hire the services of a consultant to carry out the above and develop a road asset management system.	
Road classification: -The functions and status of road networks in Angola are regulated by Decree 21/92 and 46/92 issued in 1992 -The current classification does not adequately reflect the country's administrative and organization structure (decentralization levels) -The main focus is placed on the fundamental road network and little attention is given to the complementary roads and to the municipal road network	-Review the current road network classification -Revise the current road classification based on the new road database to assert the ownership of the complementary roads (the missing middle) along with the unclassified roads.	MINCON
Sub-national roads: -The level of spending on road maintenance and rehabilitation is slightly higher than the estimated needs, but the municipal road network remains in critical condition -Almost three fourths of the total agriculture production value cannot reach markets -Half of the population is located further than 2km from	-Develop a municipality road development program based on accessibility gap analysis -Establish a road management agency at provincial level on a pilot basis	MINCON Provinces

a road. Only 37 % can access hospitals in less than 2 hours -There is no coordinated approach to complete the rehabilitation backlog -There is a lack of management and technical capacity at subnational level.		
Road contractor's industry -The unit cost of Angola's road works is higher than SSA average -There is a need to have a better understanding of the road construction industry - 54% of all public procurement activities used "Simplified Procurement" or sole source method	-Review the current unit costs of road works -Carry out a study of the road construction industry to support the development of a competitive local road contractors' industry -Use of competitive bidding methods -Develop and mainstream the use of e-procurement. Currently only used in the heath sector	MINCON

1 INTRODUCTION

Considering its regional economic position, natural endowment, and its socio-economic development aspirations, it is becoming imperative to Angola to develop a safe, clean and efficient transport sector. The bulk of transport needs are provided by the road transport sub-sector, with rail playing a less important role. Air and sea transport provide the principle modes of international passenger and freight movement respectively.

Angola has a relatively large road network (around 76,000km). However, only 18 percent is paved, and a good share of the secondary and tertiary road network is impassable during rainy seasons. When passable, average speed is less than 20km/h, rendering the commercialization of agriculture products a challenging task[1]. It takes 49–531 days to export or import goods, among the longest times in Africa. Road access is particularly problematic for firms outside Luanda. Regional road corridors are underdeveloped, and the poor road condition increases transport costs and hampers Angola's value proposition as the regional transport gateway for Southern DRC and land locked Zambia and Botswana.

Angola's 27-year civil war (1975-2002) devastated its infrastructure. For instance, most of the road network was in a very bad condition and its size shrank as a result of years of underinvestment and neglect during a civil war that ended in 2002. Poor road infrastructure and transport logistics slow Angola's overall economic development. The Government has recognized that the Angola's economy needs the support of a well-integrated and efficient transport sector and made significant efforts to reconstruct its dilapidated road infrastructure and it has established a road maintenance fund (2015).

This study has made good use of the Angola's Ministry of Finance BOOST data base to review and analyse the volume and structure of public spending in the road sector and identify any trends. The Road Network Evaluation Tools Model (RONET), developed by the World Bank, is used to evaluate the preservation (maintenance and rehabilitation) requirements of the Angola road network. A geospatial analysis is also carried out to measure the accessibility by road to agriculture markets, health centers and schools.

This road sector Public Expenditure Review (PER) examines the size and composition, allocation, and implementation of public expenditure on roads and assesses the efficiency and effectiveness of these expenditures both at the national and sub-national levels. It also reviews the overall policy and institutional framework and makes relevant recommendations.

The objectives of this road sector PER are fully aligned with the objectives of the World Bank's Country Partnership Strategy for Angola, which places a strong emphasis on supporting Angolan institutions. By working in partnership with government institutions, this review aims to assist in building capacity to analyze the efficiency of spending on roads, and to allocate funds in a way that supports effectively Angola's development.

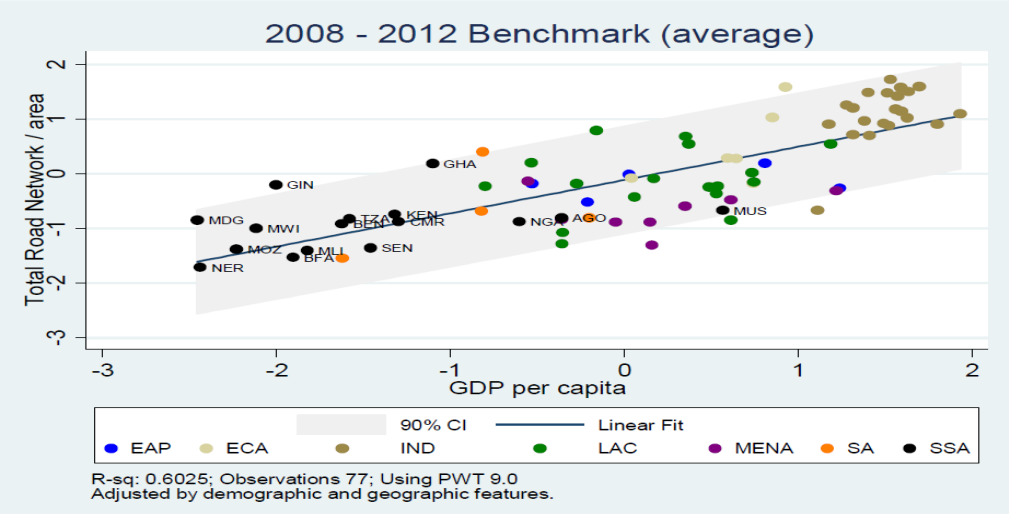
[1] INCATEMA (2018) Diagnostic of Supporting Infrastructure Current Status in the Project area. Commercial Agriculture Development Project.

2 ANGOLA ROAD NETWORK

2.1 ROAD DENSITY

Angola's road density is relatively low, compared to countries with the same level of GDP/capita. Angola's road density is lower than many Sub-Saharan Africa countries with lower GDP/capita (Figure 1). Angola has a road network of around 76,000 km or a spatial density of 6 km per 100 km2. This density varies across regions as the main road links are in the western half of the country along the coast which are in reasonable condition, while roads further inland are scarce and more dilapidated.

Figure 1: Road Density and Income per Capita

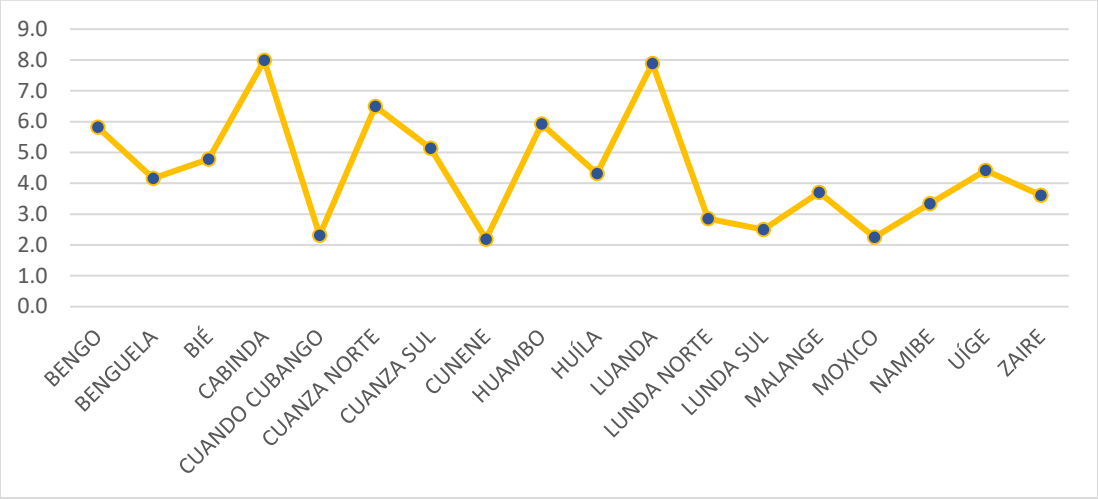


Source: Infrastructure Development in Sub-Saharan Africa. A Scorecard. The World Bank

2.2 ROAD DENSITY BY PROVINCE

The average spatial density of the classified roads is low (3.3 km per 100 km2), compared to many countries in Sub-Saharan Africa and varies across provinces (Figure 2). The spatial density is above average in the provinces along the coast (i.e. Cabinda) and below average in provinces in the central and eastern part of the country. Data on the distribution of the unclassified roads (32,345 km) by province is not available and it is not clear whether this classified road density gap is filled by the unclassified/tertiary roads which are important to provide access to basic social services.

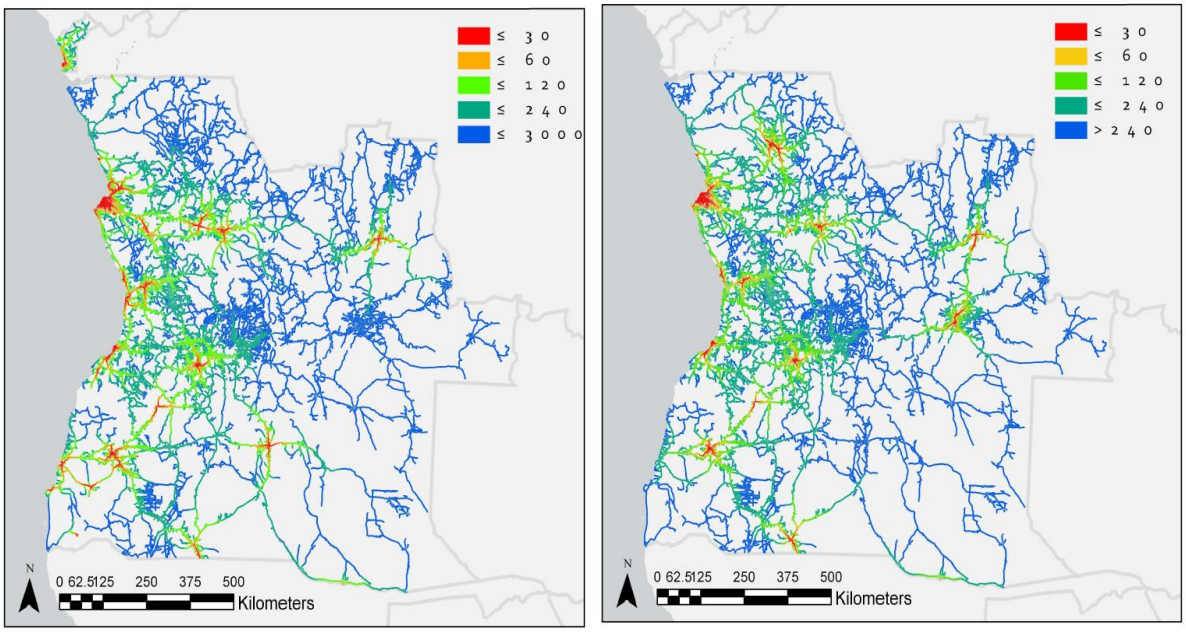
Figure 2: Spatial road density by province



Source: INAE, 2018

Half of the population is located further than 2km from any road. A geospatial analysis to measure the accessibility by road to agriculture markets, health centers and schools was carried out using data from open street mapWorldPop 2015 estimates, points of interest, and the International Food Policy Research Institute's (IFPRI) SPAM model which identifies the value of crop production The results show that access of agriculture production to main markets is poor overall, almost three quarter of the total agriculture production value cannot reach markets, and this varies across provinces. Access to social services (health centers and schools) is also poor, around half of the country's population is located further than 2km from any road and only 37% can access hospitals and schools in less than 2 hours. This travel time is much longer in provinces in the east, north and south of the country (Figure 3). This could indicate that there is a need to build new municipal roads and develop rural development programs. Detailed results of the geospatial analysis are presented in Appendix 1.

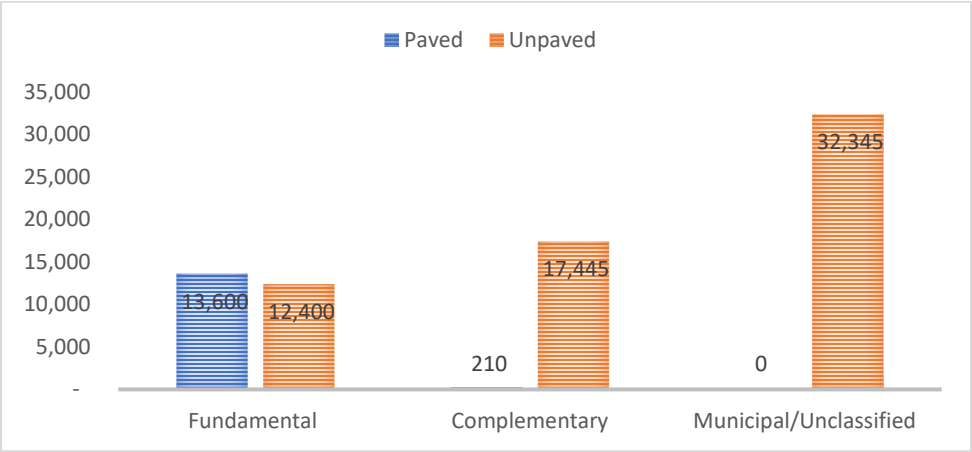
Figure 3:Travel time to reach the closest hospital and school (min)



2.3 ROAD CHARACTERISTICS

Nearly half of the total road network is unclassified roads and there is no data on their characteristics and condition. The total size of the Angola road network is around 76,000 km. The classified network is around 43,655 km in length or 58% of the total road network. This classified road network includes around 26,000 km of fundamental roads which connect the capital to the 18 provinces and the main cities to each other and to around 17,500 km of complementary roads. The fundamental road network is under the responsibility of INAE, of which around 13,600km, or 52% are paved roads. The remaining classified road network (17,500 km) are complementary roads and are also under the responsibility of INAE of which only 210 km are paved. Most of the classified roads are 6 meters wide but there are also a few road sections which are 4.5 meters wide. The remaining road network consists of around 32,345 km of unclassified local roads which provide connectivity within the 164 municipalities areas (Figure 4) and are under the responsibility of the provinces. Data on the characteristics and on the conditions of this unclassified road network is not available.

Figure 4: Angola road network



Source: INAE, 2018

Part of the fundamental road network forms the Angolan sections of the Sothern African Development Community, SADC corridors. These corridors represent a major asset in the road network. SADC identifies road corridors that are of regional importance in facilitating trade and movement between member states. These are to be developed to a common standard to support the future potential traffic demands. There are five SADC corridors within Angola:

i. Corridor 1: North – South;
ii. Corridor 2: Luanda - Soyo - Cabinda (Angola, Congo, and DRC);
iii. Corridor 3: Lobito (Angola, DRC and Zambia);
iv. Corridor 4: Malange (Angola, DRC);
v. Corridor 5: Namibe (Angola, Namibia, Botswana, Zambia).

The corridors total length is 6216 km, of which 4,628 km are paved (representing 74% of the total length). Works have already been undertaken to upgrade these corridors. The Angola National Road Institute, INEA states that upgrading involves widening and paving of the roads to bring to a SADC standard.

2.4 ROAD CONDITIONS

Angola does not carry out regular surveys about road inventory and condition and information on road conditions are either sketchy or not available. Traffic surveys are not conducted and there is no road asset management database. The National Transport Strategy and Master Plan (NTSMP) report (2018) prepared by AfDB shows that the fundamental road network is on average 45% in critical or bad condition, 18% in reasonable or good condition, and the rest is unknown. There is no available data on the conditions of the provincial and the unclassified road network.

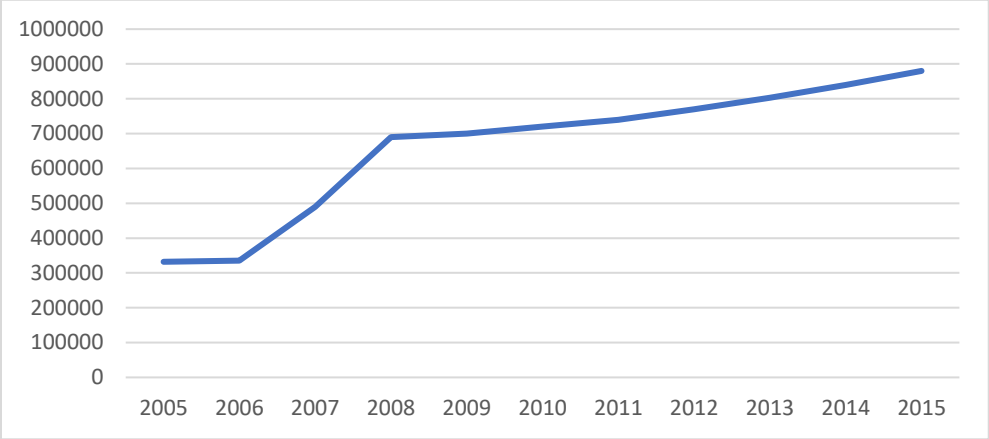
2.5 TRAFFIC VOLUMES AND COMPOSITION

There are no national roads with traffic volumes above a threshold to sustain financial viability and attract private sector financing. For the preparation of the NTSMP, traffic surveys were conducted on 31 surveys stations on the fundamental road network in 2018. The results show that the average daily traffic is around 900 vehicles. The highest traffic volume was observed on the Dande – Ambriz road section, with a total two- of almost 4,000 vehicles, the second highest traffic volume is around 2500 vehicles. The lowest traffic volumes observed are below 100 vehicles. Most of the highest traffic volumes are along the coast while traffic volumes in the central and east part of the country are low. There are no national roads with traffic volumes above a threshold to sustain financial viability and attract private sector financing. Light vehicles represent around 75 percent of the traffic, public transport (buses) and trucks represent 11 and 13 percent respectively.

2.6 DEMAND FOR ROAD SERVICES

Demand for road services is increasing and vehicle ownership is concentrated in Luanda. The demand for road transport is increasing rapidly as the vehicle fleet has grown by 2.6 times over the 2005-2015 period or at 10 percent a year. The total vehicle fleet reached 880,000 million in 2015 (Figure 5) and will be around 1.4 million vehicles by 2020 using the same annual growth rate. The motorization is only 45 vehicles per 1,000 people, but with an income of US$3,600 per capita, growth in the vehicle fleet is likely to continue at a rapid pace unless there are policy interventions on vehicle ownership and use. The concentration of around 36 percent of the vehicle fleet in Luanda will exasperate congestion problems. Authorities face trade-offs between allowing market forces to prevail for vehicle ownership and use based on current taxation levels, or to intervene by reducing demand through higher taxation, a reduction in fuel subsidies and stricter regulation. International experience shows that urban congestion needs a combination of measures to optimize city travel including fiscal policy, transport demand management and substantial investments in public transportation. Special regulations are also frequently needed to control two-wheeled traffic, especially motorcycles.

Figure 5: Angola vehicle fleet



Source: International Organization of Vehicle Manufacturers, 2018

2.7 ROAD SECTOR INSTITUTIONAL SET UP

The road sector is under the responsibility of the Ministry of Construction and Public Works. The National Road Institute (Institute de Estradas de Angola, NAE), which is part of the Ministry of Construction and Public Works (MPW), has responsibility for the management and development of the fundamental and complementary road networks (26,000 km and 17,500 km respectively. INAE has also a supporting advisory role to the unclassified roads, managed by the provinces/municipalities. INAE has regional offices in each of the 18 provinces and employs a total of around 700 staff. The INAE staff/network level of 1.6 staff/100km is close to the internationally recommended efficiency level of two staff/100km and compares well with many good practice agencies in Sub-Saharan Africa (Table 1)

Table 1: Road agencies* staff efficiency

INAE Comparison to Roads Agencies*	Length of national network (km)	Total Number of Staff	Staff/100 km
Angola (INAE)	43,000	700**	1.6
Uganda	20,800	916	4.2
Tanzania	33,012	719	2.2
Namibia	15,819	278	1.8
New Zealand	10,906	189	1.7
South Africa	16,170	195	1.2

Source: World Bank, **INAE**

*Road Authorities with their construction and maintenance works contracted out to the private sector. **Excluding support and contractual staff, but including INAE regional offices who work on fundamental roads

In addition to INAE, DNIP (Direcção Nacional de Infra-Estruturas Públicas) is responsible for the coordination and technical control of the construction of public infrastructure and DNOE (Direcção Nacional de Obras Engenharia) is responsible for the management of all projects related to bridges with a total length of more than 10m.

Road Fund: The Angola road fund was established by a Presidential decree in 2015. The road fund is dedicated to financing maintenance works of the fundamental and complementary road networks. The road fund employs around thirty staff and has a board of directors, an advisory council and a supervisory board. A decree in 2019 made two main amendments to the legislation (i) the road fund to report to the

Ministry of Construction and Public Works instead of the Ministry of Finance (MINFIN) and (ii) the transfer of the function of procurement of road maintenance activities from the road fund to INAE. As per the presidential decree, the road fund revenue includes a fuel levy, vehicle license fee, vehicle and spare parts import taxes, and road tolls. The Ministry of Finance also allocates a yearly budget for emergency road works. However, revenues are not channeled directly to the road fund as per the presidential decree. MoF allocates an annual budget mainly to cover the cost of emergency road works.

Unclassified roads (Municipal roads). The Direcção Provincial Dos Transportes, Telecomunicações, E Tecnologia De Informação in each of the 18 provinces manages the unclassified roads (municipal roads). Provincial governments also identify priorities for road improvements/maintenance, select contractors for the execution of services and supervise unclassified road works. INAE regional offices provide support and equipment to municipalities for emergency works. There is a lack of technical capacity at provincial level. For instance, the Directorate of transport of Huila, second largest province after Luanda, has 29 staff including two architects and four engineers but has no road engineers.

Revenue from local taxes is insignificant, sub-national government rely on central government transfers. The so-called ordinary central government transfers are essentially financial quotas defined by the MINFIN[2] for specific recurrent and capital purposes. The size of the financial quotas is ad hoc, with the allocation negotiated each year, mainly between provinces and central government, and approved by the State annual budget law. Based on 2015-2017 municipal revenue data, approximately one-third of the municipalities have ordinary transfers as their only source of revenue. At present time, municipalities' revenue autonomy is largely confined to the management of central sources. Central government transfers including shared taxes represent the quasi-totalities of municipalities' revenue. Local taxes represent less than 0.5 percent of the total revenues.

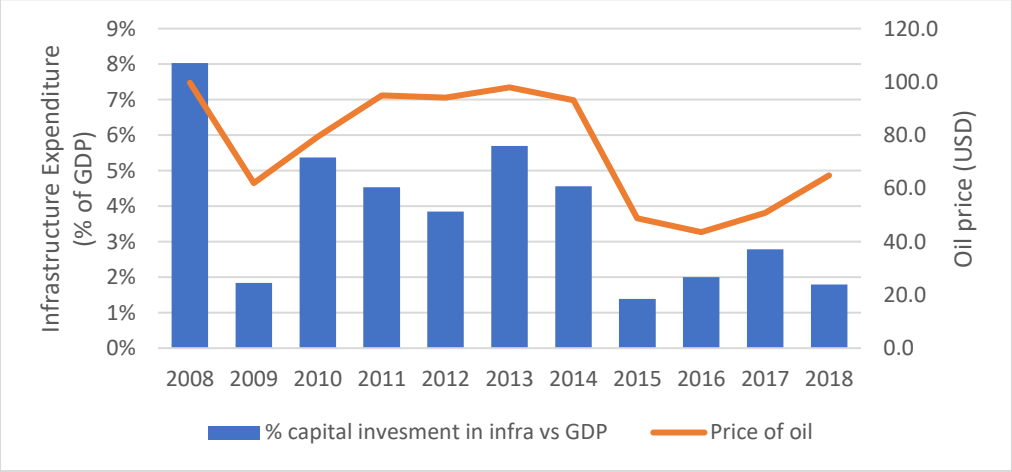
[2] MINFIN allocates the transfers. However, the Ministry of Planning and line ministries participate in the definition of the financial quotas.

3 PUBLIC EXPENDITURE

3.1 PUBLIC EXPENDITURE ON INFRASTRUCTURE

Angola has spent a total of around US$US45 billion on its infrastructure over the last decade (2008-2018), or around US$4.5 billion/year. By the end of the civil war in 2002, the Government of Angola has launched a large infrastructure reconstruction program spending on average US$4.4 billion per year on infrastructure between 2002-2009. This effort was sustained over the last decade (2008 -2018) and Angola spent on average 4.1% of its GDP per year on its infrastructure sector (Figure 6). Angola's infrastructure public expenditure is on a par with the average expenditure of Lower and Medium Income Countries (4% of GDP for 2011) and is nearly twice more than Sub-Saharan African countries (2.54% of GDP)3, Table 2. The variation in public expenditure on infrastructure4 has followed the variation in oil revenues over the same period. Public expenditure has decreased following the 2014-15 oil-price dive.

Figure 6: Infrastructure public expenditure as % of GDP (2008-2018)



Source: MINFIN

Table 2: Infrastructure investment as % of GDP, by scenario and region, 2011

Region	*Lower-bound estimate*	*Central estimate*	*Upper-bound estimate*
East Asia and Pacific	5.36	5.72	6.71
Europe and Central Asia	1.51	2.73	4.36
Latin America and Caribbean	2.02	2.39	3.22
Middle East and North Africa	1.67	4.79	4.73
South Asia	3.59	4.42	4.25
Sub-Saharan Africa	1.87	2.54	3.47
LMIC average	**3.38**	**4.11**	**4.99**

Source: Beyond the Gap. How Countries Can Afford the Infrastructure They Need while Protecting the Planet. Policy Note 1/6. World Bank (2018)

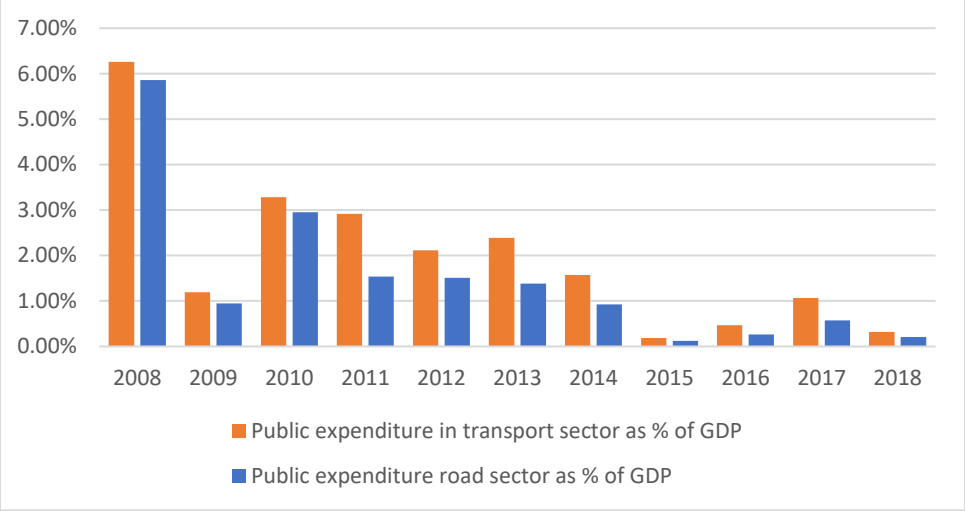
[3] How much is needed? Infrastructure investments for sustainable development, World bank, 2019

[4] Infrastructure sectors include transport, energy, water and sanitation, irrigation urban infrastructure

3.2 PUBLIC EXPENDITURE ON THE TRANSPORT SECTOR

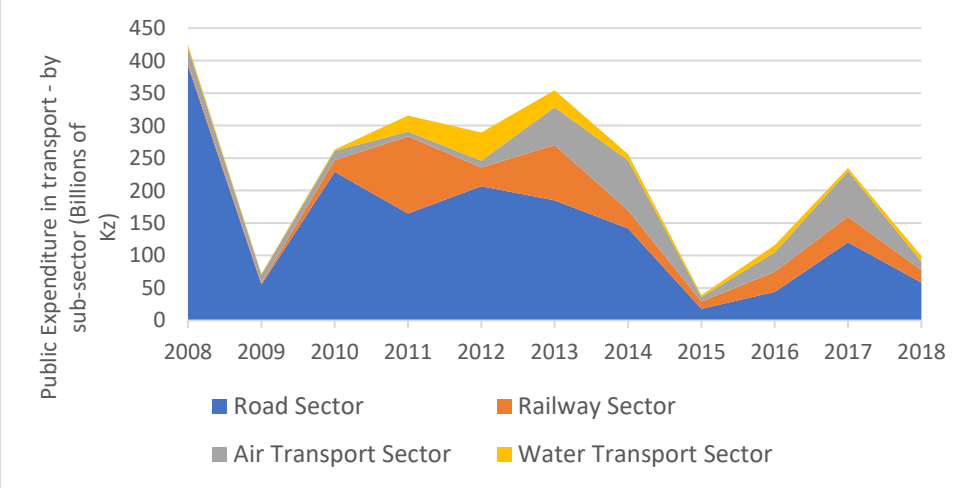
Most of the public expenditure on infrastructure was in the transport sector of which more than two-thirds were spent on roads. The lion share of Angola's infrastructure public expenditure was spent on the transport sector and around three-quarters of the public expenditure in the transport sector was on the road sub-sector (Figure 7), followed by the railway, port and the air transport sub-sectors (Figure 8).

Figure 7: Public expenditure in the transport and the road sectors as % of GDP (2008-2018)



Source: MINFIN

Figure 8: Public expenditure in the transport sector by mode of transport



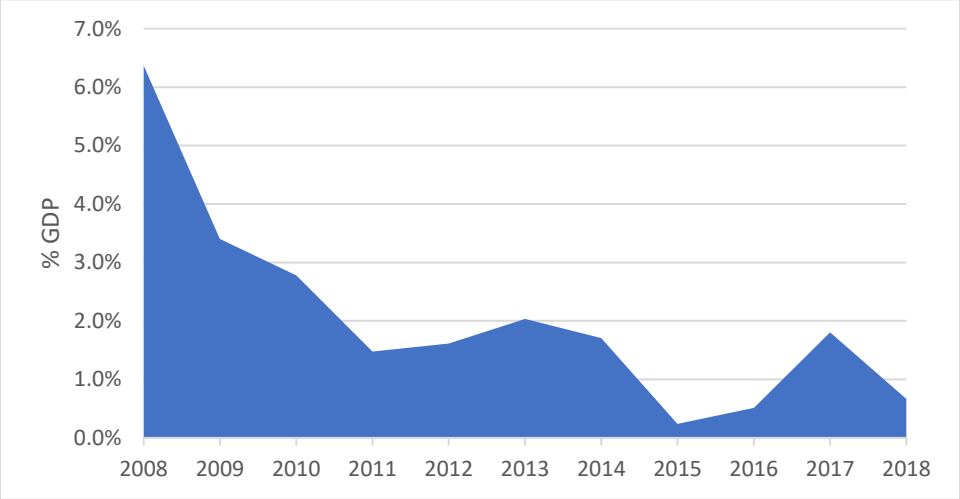
Source: MINFIN

3.3 PUBLIC EXPENDITURE ON THE ROAD SECTOR

Angola has spent an unprecedented amount to salvage its road network but the share of public expenditure on road maintenance is negligible. Angola's 27-year civil war (1975-2002) devastated its infrastructure. For instance, most of the road network was in a very bad condition and its size shrank by around 20,000 km as a result of years of underinvestment and neglect during the civil war that ended in 2002. In addition, more than 300 bridges of varying lengths and capacities have been destroyed and

needed urgent rehabilitation. Angola has therefore made unprecedented effort to rebuild its dilapidated road network during the first post-civil war years and has spent on average US$2.8 billion/year[5] in road re-opening programs (2002-2009). This effort was pursued over the 2008-2018 period and around US$2.1 billion/year or 2.1% of Angola's GDP was allocated each year to the road sector (Figure 9).

Figure 9: Road sector expenditure as % of GDP (2008-2018)



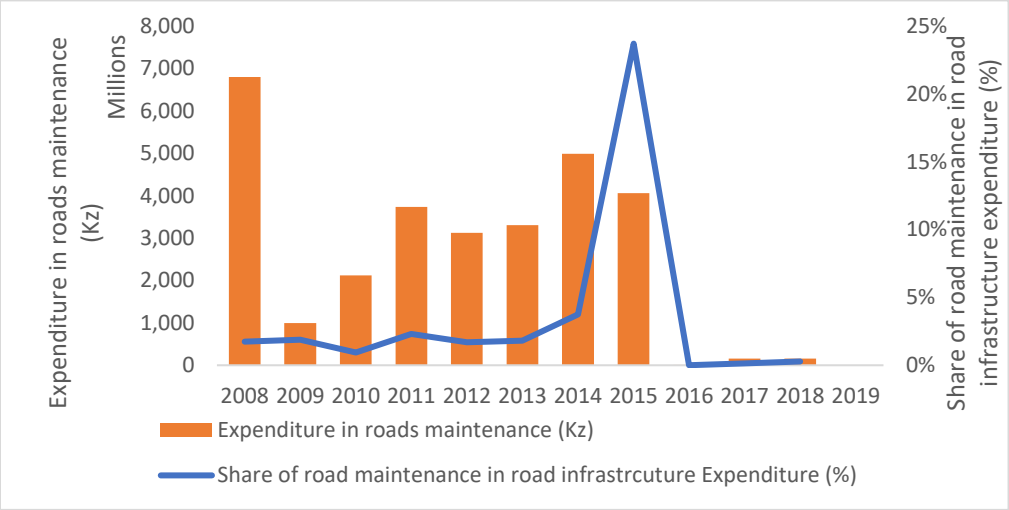
Source: MINFIN

With the decline in oil revenue since the 2014-15 oil-price shock, the public investment program has been increasingly financed by external project loans. The Government recognizes that the extent of the road sector rehabilitation backlog is significant and has launched road salvation programs using external financing sources. The implementation of the first road rehabilitation program (2013-2017) worth US$176m has achieved only around half of its objectives. The Government is currently implementing a second "road salvation program" for the 2018-2022 period. This program is mostly (65%) financed externally by China credit line, German commercial Bank, Eurobonds and other bilateral (Portugal) and multilateral financing partners (AfDB).

The shift from road development to road maintenance has not occurred during the last decade. The quasi-totality (97%) of the public expenditure on the road sector was allocated to capital expenditure during the 2008-2018 period. During this period, the share of road maintenance expenditure was on average 3.5% of the total expenditure on roads, or $US28.0 million on average per year over the same period (Figure 10 and 11). There was a sharp increase in the share of road maintenance expenditure (25%) in 2015 which could be explained by the creation of the road fund (2015) but hardly any road maintenance expenditure was undertaken during the last three years (2015-2018). Oil revenues have taken a sharp decline during this same period and road maintenance has subsequently not become a priority.

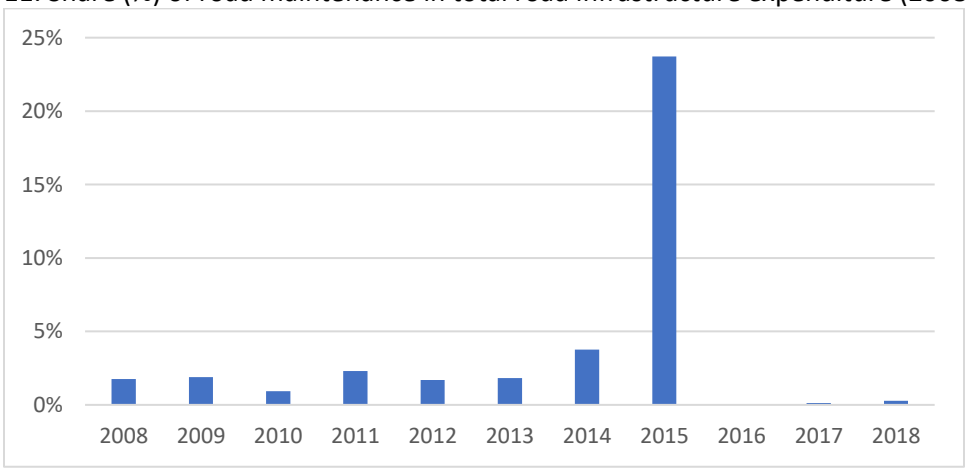
[5] Pushak and Foster (2011), *Angola's Infrastructure: A Continental Perspective*, p. 18.

Figure 10: Public expenditure on road maintenance (2008-2018)



Source: MINFIN

Figure 11: Share (%) of road maintenance in total road infrastructure expenditure (2008-2018)



Source : MINFIN

3.4 PUBLIC EXPENDITURE AT SUBNATIONAL LEVEL

Public expenditure is highly concentrated at the central government level, with only few public resources allocated to subnational entities. As a share of Angola's GDP, central, provincial and municipal spending[6] represent 34%, 5% and 1% respectively over the 2008-2016 period (Figure 12). Central, provincial and municipal expenditures represent respectively on average 86%, 12% and 2% of the total public expenditure on all the sectors of the economy (Figure 13). The decrease in the central

[6] Central government spending includes the ministries and their reporting entities, public institutions, and expenditures from the legislative and judicial branches.

government spending since 2014 (from 47.7% to 28.7 of GDP) is largely attributable to the decline of oil prices.

Figure 12: Public Expenditure trends by level of government in Kz (% GDP), 2008–2016

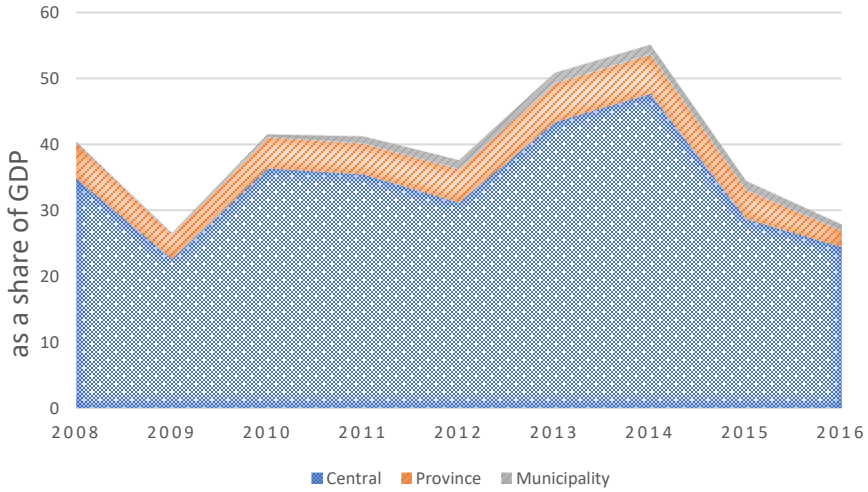
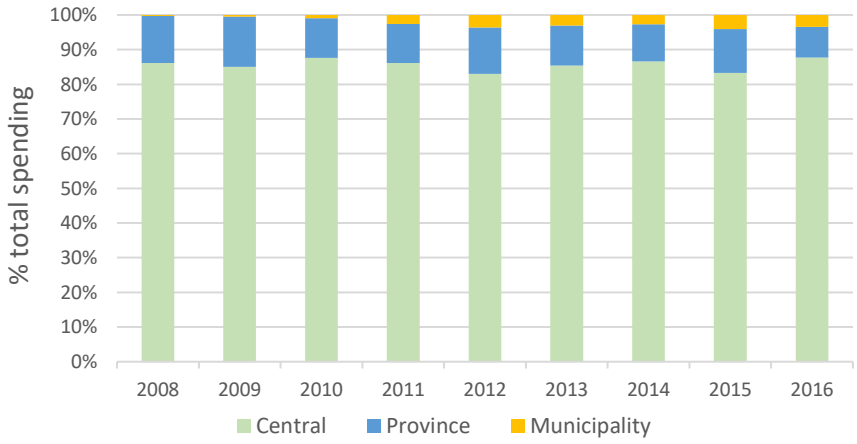


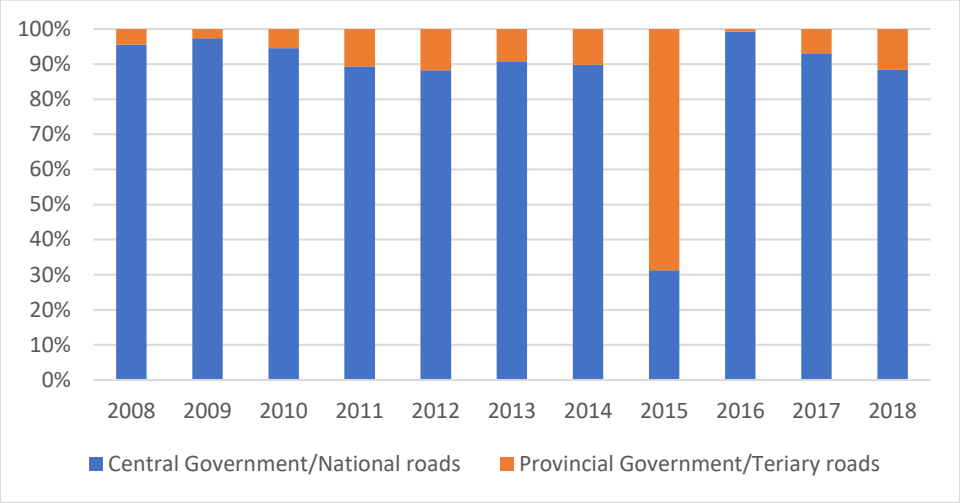
Figure 13: Expenditure trends by level of government, 2008-2016 (% total spending)



Source: MINFIN.

Only a small fraction of the road sector expenditure is allocated to tertiary/municipal roads. Road allocations to provincial level represent on average 13% of the total expenditure on the road sector over the 2008-2018 period. Most (87%) of Angola road sector expenditure is allocated to national roads (Figure 14).

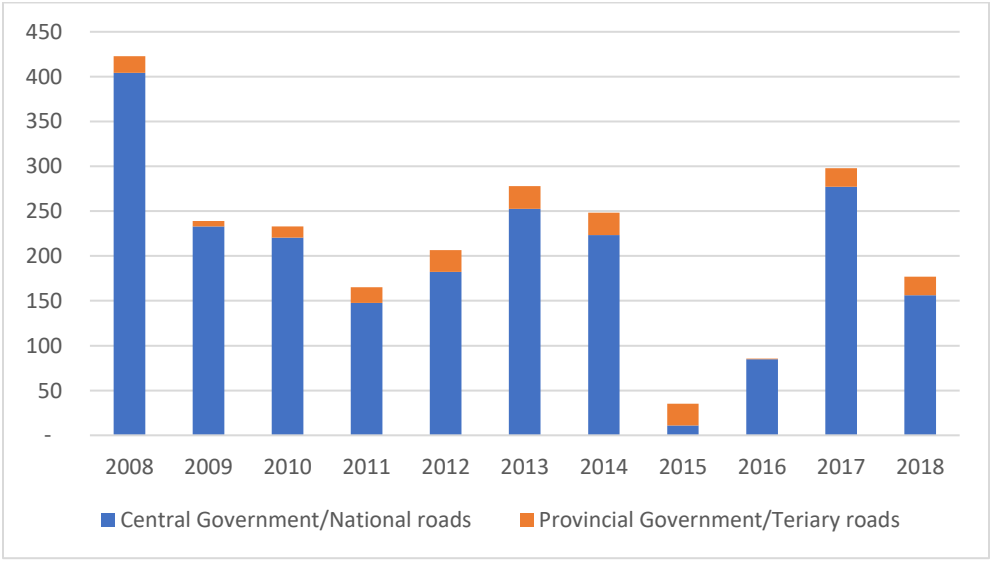
Figure 14: Share of road sector expenditure at central and sub-national levels (2008-2018)



Source: MINFIN.

This trend was reversed for the 2015 year where subnational roads were allocated around 70% of the total expenditure on road sector but in absolute terms, this represents only around 24 billion Kwanzas, or around $US19.0 million (Figure 15).

Figure 15: Road sector expenditure at central and sub-national levels (in Billion Kz), (2008-2018)



Source: MINFIN.

4 HOW EFFICIENT IS PUBLIC SPENDING IN THE ROAD SECTOR?

4.1 NATIONAL ROADS

Assessing the efficiency of road sector expenditure in Angola is a challenge. The expenditure on road sector based on the MINFI BOOST database (2008-2018) is well described in chapter 2. However, data on outputs, including length of roads paved, rehabilitated and maintained is not? available. INAE has no road database or road asset management system and data at subnational level is scarce. An estimate of the road sector outputs over the 2008-2018 period is based on an analysis of aggregate data described in the National Development Plan (NDP 2013-17), the National Transport Sector Master Plan (2019) and the limited data from the Ministry of Construction and Public Works (MINCON) for the 2001-2013 period and from INAE for 2013-2017.

Angola's efforts to rebuild its road network were below the ambitious targets set in its National Development Plans. According to the Ministry of Construction and Public Works, as a result of the effort made to rebuild its road network, Angola has rehabilitated/paved 6402 km[7] over the post-civil war period 2002-2010, or around 800km/year with a further 3330 km rehabilitated between 2011-2012. During 2013-2017, INAE data as reported in the National Transport Strategy Master Plan report (2018), shows that 3259.8 km were rehabilitated. It is therefore estimated that a total of around 8200 km of roads were paved/rehabilitated over the whole 2008-2017 period (Table 3). This is below the ambitious target of 15,500 km of primary roads and 6,000 km of secondary roads set by the National Development Plan, NDP (2013-2017).

Table 3: Length of national roads paved and rehabilitated and expenditure (2008-2017)

Year/period	**Paved/rehabilitated** (Km)
2008-2010	1601.0
2011-2012	3330.0
2013	1171.1
2014	1335.7
2015	321.1
2016	111.1
2017	320.4
Total (2008-2017) (in km)	**8190.4**
Total spending (2008-2017) (in US$ billion)	**US$20.64**
Unit cost (US$ million/km)	**2.52**

Source: INAE/NTSMP, MINCON, MINFI, World Bank estimates

Real increases in spending have not been accompanied by commensurate increases in physical road output. During the period (2008-2017), central government has spent a total of around US$20.64 billion on national roads, or around US$2.52 million/km. This is a very high unit cost compared to an average unit cost to build a new two-lane road which, on the high range, is estimated to be around 0.8-1.0 million/km. Considering the total amount of road sector expenditure during this same period of around US$20.64 billion, Angola could have added a total of around 25795 km of new roads to its national network (Table 4) or three times more than the actual road length (8200km)reported by INAE and

[7] Angola's Infrastructure Ambitions Through Booms and Busts Policy, Governance and Reform, Research Paper Søren Kirk Jensen Africa Program, September 2018

MINCON. The potential increase in physical outputs would be much higher (31266 km) in the case the total spending was used to undertake reconstruction works.

Table 4: Central government level spending on roads and potential physical road outputs

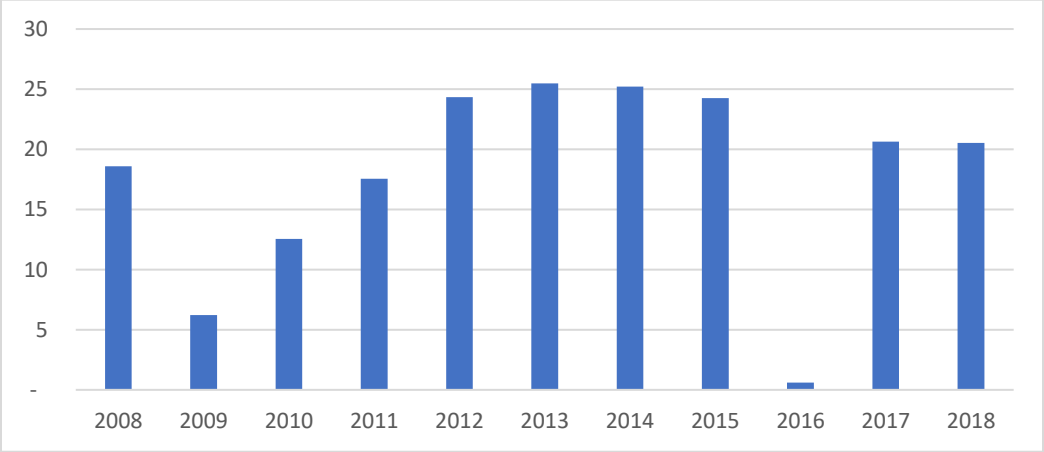
	Average road expenditure at central Government level (US$ Billion/year)		**Total (US$ Billion)**
Time period (2008-2017)		2.06	20.64
Current Condition	***Asphalt Mix Road Work Type***	***Two-Lane Unit Costs of Road Works (US$/km)***	***Total (km)***
Critical condition	Reconstruction	660,000	31266
No Road	New Construction	800,000	25795

Source: MINFI, World Bank estimates

4.2 UNCLASSIFIED/MUNICIPAL ROADS

Angola could have added a total of around 34,000 km of new sub-national roads or two-thirds of the current length of its municipal road network. During the 2008-2017 period, around 17.5 billion Kwanzas/year, on average, were spent on provincial/tertiary roads (or an equivalent of US$171 million/year), Figure 15. These allocations/expenditures were erratic and varied from 1.0 to 25 billion Kz over this period. With the assumption that the entire allocations was spent on municipal/tertiary/unclassified road network of 33,000 km, the average unit cost would be around US$51,815/km. This is more than a unit cost of a full reconstruction of a two-lane earth road on the high range. Considering the total amount of the sub-national road sector expenditure during this same period was around US$1.71 billion, Angola could have added a total of around 21350 km of new municipal roads or two-thirds of the current length of its municipal road network. The potential increase in physical outputs would be much higher (34198km) if the total spending was used to undertake reconstruction works (Table 16).

Figure 16: Spending on sub-national roads (in Billion Kz), (2008-2018)



Source: MINFIN.

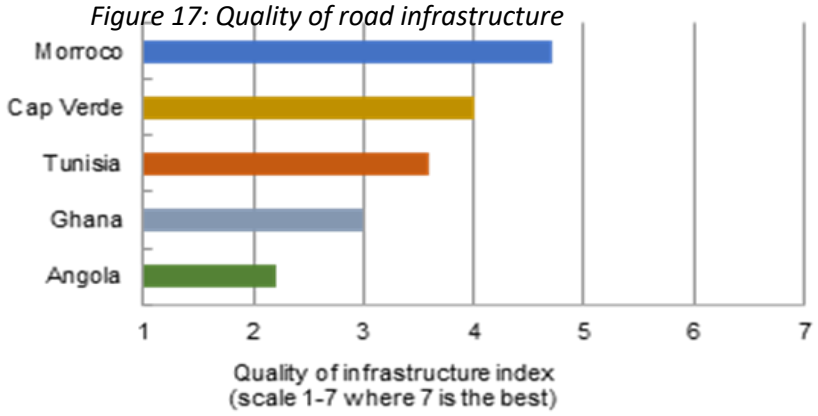
Table 5: Sub-national government level spending on roads and potential physical road outputs

	Average road expenditure at sub-national Government level (US$ Million/year)		Total (US$ Billion)
Time period (2008-2017)		171.0	0.171
Current Condition	***Earth Road Work Type***	***Two-Lane Unit Costs of Road Works (US$/km)***	***Total (km)***
Critical condition	Reconstruction	50,000	34198
No Road	New Construction	80,000	21374

Source: MINFI, World Bank estimates

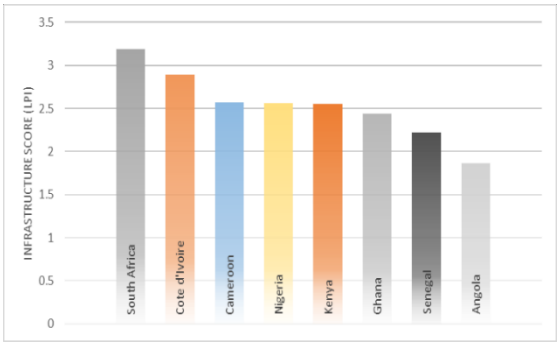
The impact of recent investment levels is minor and can be seen in the poor-quality of infrastructure in Angola. The quality of Angola's road infrastructure is ranked 136th out of 141 countries, based on the 2019 Global Competitiveness Report. Angola's score is 2.2 out of 7 and is one of the lowest in the Africa region. Angola is lagging behind countries with the same GDP/capita (US$3,600/cap) (Figure 17 as well as many countries with lower GDP/cap (i.e. Ghana, Senegal, Cote d'Ivoire…). Angola ranks 159 out of 160 countries in the 2018 Logistics Performance Index (LPI)[8] and 153 out of 160 in the Infrastructure Performance component of the LPI[9] (Figure 18). This low quality of infrastructure is one factor constraining further improvements in Angola's competitiveness ranking.

Figure 17: Quality of road infrastructure



Source: Connecting to Compete 2018, Trade Logistics in the Global Economy, The World Bank

Figure 18: LPI Score in major economies in SSA



[8] Connecting to Compete 2018, Trade Logistics in the Global Economy, The World Bank

[9] The logistics performance (LPI) is the weighted average of the country scores on the six key dimensions:
i) Efficiency of the clearance process (i.e., speed, simplicity and predictability of formalities) by border control agencies, including customs; ii) Quality of trade and transport related infrastructure (e.g., ports, railroads, roads, information technology); iii) Ease of arranging competitively priced shipments; iv) Competence and quality of logistics services (e.g., transport operators, customs brokers); v) Ability to track and trace consignments; 6) Timeliness of shipments in reaching destination within the scheduled or expected delivery time.

5 ROAD SECTOR FINANCING NEEDS

5.1 ROAD SECTOR FINANCING NEEDS ASSESSMENT APPROACH.

Most of the road network in Angola is in poor condition and the opportunity cost of neglecting road maintenance is high. The Road Network Evaluation Tools Model (RONET) developed by the World Bank, was used to evaluate the preservation (maintenance and rehabilitation) requirements of the Angolan road network. RONET is a tool for evaluating the performance of road maintenance and rehabilitation strategies and the importance of the road sector to the economy. It assesses the current network condition and traffic and computes the asset value of the network and road network monitoring indicators. It uses country-specific relationships between maintenance spending and road condition and between road condition and road-user costs, to assess the performance over time of the network under different road works standards. It determines, for example, maintenance and rehabilitation road works that minimize total transport costs or the cost for sustaining the network in its current condition. It also estimates the savings or the costs to the economy to be obtained from maintaining the network at different levels of service. In addition, it determines the allocation of expenditures between recurrent maintenance, periodic maintenance, and rehabilitation road works. Finally, it can be used to determine the "funding gap," defined as the difference between current maintenance spending and required maintenance spending (to maintain the network at a given level of road condition), and the effect of under-spending on increased transport costs.

5.2 INPUT DATA ASSUMPTIONS

The available information allows only for a macro evaluation of the network. RONET performs a macro evaluation of the network for monitoring and strategic planning purposes by characterizing the road network using road categories of functional classification, surface type, condition and traffic. Thus, one of the main inputs to RONET is the distribution of the network length by different road categories, together with the average unit costs of road works and vehicle fleet characteristics. The data gaps were filled by making assumptions based on available information including unit costs of road works in Africa region and by revising the default data used by RONET to take into consideration the country context (i.e. Road work unit costs).

Road network size and condition

The assessment of road financing needs is undertaken for the whole road network (76000km) as presented in Figure 2. Separate road financing needs estimated for (i) the fundamental road network (26000 km); (ii) the complementary road network (17000 km) and (iii) the unclassified/municipal road network (33000 km). Road network condition estimated for each road network class based on the results of road inventory and condition carried out on around 19000 km of paved and unpaved roads under the Transport National Strategy, NTSMP, prepared by AfDB (2018). The estimates show that the share of the road network in poor and critical condition for the paved, unpaved and unclassified roads is 25%, 60% and 80%. The results show that around two-third (64%) of the total rod network is in poor or critical condition. This result is well aligned with the road conditions reported in the National Transport Strategy and Master Plan (NTSMP, 2018). The road condition data used to estimate the financing needs of the total road network of 76,000 km is presented in Table 6.

Table 6: Network length by type and road condition (km)

Network	Fundamental Paved	Fundamental and complementary Unpaved	Unclassified Municipal	Total Average
Road Condition		**%**		
Very Good	2%	0%	0%	0%
Good	41%	15%	5%	13%
Fair	36%	25%	15%	20%
Poor	12%	35%	45%	38%
Very Poor	8%	25%	35%	28%

Road traffic

Traffic composition and average traffic volume using each class of road was derived from the traffic counted on 30 survey stations conducted for the preparation of the NTSMP in 2018. Traffic composition and the share of traffic using each type of road class is presented in Table 7.

Table 7 :Traffic composition and volume by road network type

Vehicle type	%	Daily Traffic (AADT)		Fundamental Paved	Fundamental & Complementary Unpaved	Unclassified Municipal
		From	To		(%)	
Private Vehicle	34%	0	10	0%	0%	0%
Delivery Vehicle	7%	10	30	0%	0%	25%
Truck Light	4%	30	100	3%	25%	50%
Truck Medium	2%	100	300	27%	50%	25%
Truck Heavy	2%	300	1000	23%	25%	0%
Truck Articulated	5%	1000	3000	37%	0%	0%
Bus Light	4%	3000	10000	10%	0%	0%
Motorcycles	42%	10000	30000	0%	0%	0%

Road works unit costs

Data on unit costs of road works in Angola was not made available to carry out a country specific analysis. Unit cost estimates were made based on road projects undertaken in Africa. Table 8 presents a summary of a study of road unit costs commissioned by the African Development Bank (AfDB). Road projects financed by the World Bank and AfDB were considered from Benin, Botswana, Burkina Faso, Cameroon, Chad, Ethiopia, Ghana, Morocco, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, São Tomé and Principe, Swaziland, Tanzania, Tunisia, and Uganda. The projects were contracted through 2000-2010. The unit costs in the report are in terms of lane-kilometers. The values are double the report values to relate to two-lane roads and have been updated from 2006 values to 2018 using the USA CPI. One set of statistics is provided for projects smaller than 50 (two-lane) km (typically subject to a large variance) and those larger than 50 (two-lane) km (typically demonstrating small variance).

Table 8: Unit costs for road works in Africa (US$ thousand per two-lane km)

Project length and statistic	Re-graveling / periodic maintenance of unpaved roads	Periodic maintenance of paved roads	Rehabilitation of paved roads	Construction and upgrading of paved roads
< 50 km				
Upper quartile	24.8	-	684	1,004
Median	22.6	-	426	538
Lower quartile	19.2	-	260	392
⩾ 50 km				
Upper quartile	30.2	170	308	382
Median	26.6	152	200	348
Lower quartile	22.6	134	112	274

Source: Study on Road Infrastructure Costs: Analysis of Unit Costs and Cost Overruns of Road Infrastructure Projects in Africa, African Development Bank, May 2014.

Of the projects analyzed, local contractors were generally used for maintenance of unpaved roads. Contractors from the UK and France were used for a third of the periodic maintenance projects on paved roads, with local contractors used for the other periodic maintenance projects. Seventy-five rehabilitation projects were analyzed. Of these, seventeen projects used local contractors, thirty-three projects used contractors from a range of countries (China, France, Italy, Netherlands, Portugal and South Africa), and the contractor's nationality was not reported for the remaining projects. Fifty-four construction/ upgrading projects were included in the analysis. Local contractors were used on eight of these projects, international contractors (Brazil, China, France, Germany, Italy, Kuwait, Netherlands and South Africa) were used on twenty-eight of the projects, and the contractor's nationality was not reported for the remaining eighteen projects. Table 9 presents unit costs for road works in Sub-Saharan Africa financed by the World Bank. The values are for a 2-lane, 7-metre wide road equivalent, and have been updated from 2007 values to 2018 using the USA CPI.

Table 9: Average unit costs for road works in Sub-Saharan Africa (1,000US$ per two-lane km)

Country	Re-graveling of unpaved roads	Periodic maintenance of paved roads	Rehabilitation and reconstruction	Upgrading of gravel roads to paved
Congo	77.6			
Congo (DRC)	75.0		260	
Ethiopia			443	368
Ghana			298	
Kenya			1,090	
Madagascar	62.2	120		
Malawi			480	
Mozambique		225	318	
Tanzania				397
Uganda				479
Zambia	28.5	100		

Source: Monitoring Road Works Contracts and Unit Costs for Enhanced Governance in Sub-Saharan Africa. Transport Paper TP-21, World Bank, September 2008.

The average costs for rehabilitation and reconstruction works is particularly high in Kenya in comparison to other countries in the sample. The data for Kenya relates to four contracts with an asphalt mix pavement course and bituminous base. Of the projects analyzed, local African firms executed 43%, Chinese firms 27%, European firms 17%, firms from other African countries 8%, and firms from outside Africa and Europe 5%. Review of costs of road construction projects in Ethiopia[10] found that the average

[10] Review of Costs of Road Construction Projects in Ethiopia, Report No. ACS14210, World Bank Group, June 2015.

cost for upgrading a gravel road to asphaltic concrete (AC) standard was US$ 710,000 per kilometer, with maximum and minimum values of US$ 1.04 million and US$ 504,000 respectively at January 2018 prices. Unit costs used to estimate road rehabilitation and maintenance needs in Angola are based on a 2010 study of unit costs of road works in Africa. This analysis has led to using conservative unit costs twice higher than the unit costs used by default by RONET. Table 8 presents the average unit costs per km per road roughness level for a two-lane road for capital and recurrent maintenance works.

Table 10: Two-lane Unit Costs (US$/km) of Road Works by surface type and condition

Surface Type	Current Condition	Road Work Class	Road Work Type	(US$/km)
Asphalt Mix	Good Condition	Periodic Maintenance	Preventive Treatment	24,000
	Fair Condition		Resurfacing (Overlay)	200,000
	Poor Condition	Rehabilitation	Strengthening (Overlay)	400,000
	Very Poor Condition		Reconstruction	660,000
	No Road	New Construction	New Construction	800,000
Surface Treatment	Good Condition	Periodic Maintenance	Preventive Treatment	24,000
	Fair Condition		Resurfacing (Reseal)	54,000
	Poor Condition	Rehabilitation	Strengthening (Overlay)	320,000
	Very Poor Condition		Reconstruction	520,000
	No Road	New Construction	New Construction	660,000
Gravel	Good Condition	Periodic Maintenance	Spot Re-gravelling	6,000
	Fair Condition		Re-gravelling	34,000
	Poor Condition	Rehabilitation	Partial Reconstruction	80,000
	Very Poor Condition		Full Reconstruction	120,000
	No Road	New Construction	New Construction	160,000
Earth	Good Condition	Periodic Maintenance	Spot Repairs	400
	Fair Condition		Heavy Grading	1,600
	Poor Condition	Rehabilitation	Partial Reconstruction	16,000
	Very Poor Condition		Full Reconstruction	50,000
	No Road	New Construction	New Construction	80,000

Recurrent Maintenance Works Unit Costs (US$/km-year)

		Two-Lane Unit Costs of Road Works (US$/km-year)				
Surface Type	Road Condition	Paved	Unpaved	Tertiary	Urban	Unclassified
Cement Concrete	Very Good	4,000	4,000	4,000	2,000	2,000
	Good	5,000	5,000	5,000	2,500	2,500
Asphalt Mix	Fair	6,000	6,000	6,000	3,000	3,000
	Poor	3,000	3,000	3,000	1,500	1,500
Surface Treatment	Very Poor	3,000	3,000	3,000	1,500	1,500
Gravel	Very Good	2,000	2,000	2,000	1,000	1,000
	Good	2,500	2,500	2,500	1,252	1,252
	Fair	3,000	3,000	3,000	1,500	1,500
	Poor	1,500	1,500	1,500	750	750
	Very Poor	1,500	1,500	1,500	750	750
Earth	Very Good	600	600	600	300	300
	Good	900	900	900	450	450
	Fair	1,200	1,200	1,200	600	600
	Poor	600	600	600	300	300
	Very Poor	600	600	600	300	300

5.3 ESTIMATION OF ROAD REHABILITATION AND MAINTENANCE NEEDS

RONET evaluated the network performance under different preservation standards in order to determine the optimal requirements for recurrent maintenance, periodic maintenance and rehabilitation. For each road class, RONET identified the standard that minimizes the present value of total transport costs (road agency costs plus road user costs), at a discount rate, thus maximizing society net benefits (NPV). The RONET evaluation adopted the following assumptions: (i) traffic growth rate of 3%/year (ii) discount rate of 6% and (iii) 20 years evaluation period; (iv) unit costs of road works based on the highest road work costs in Africa; and (v) average unit road user costs based on current average vehicle fleet characteristics in Angola.

RONET results show that the current road network asset value is around US$11.250 billion or around 11.0% of Angola's GDP. The current asset value as a share of maximum road asset value is 74.5%. This indicates that more than 25% of the road network asset value is lost due to lack of maintenance or deferred road rehabilitation work. RONET estimates the total road network preservation annual requirements, considering the scenario that minimizes total transport costs[11] for each road class, for rehabilitation, periodic maintenance and routine maintenance in years 1 to 5 and in years 6 to 20. In this analysis, the following definitions are used:

- Periodic maintenance costs are the costs of road works applied to roads in good and fair condition;
- Pavement rehabilitation costs are the costs of road works necessary for roads in poor or very poor condition;
- Routine maintenance costs are applied to all the roads.

Table 11 below presents the required expenditures without budget constraints over the next five years and in years 6 to 20, in US$ million per year. Over the next five years, a total of **US$ 924.8 million** per year is needed for rehabilitation (US$613.2m), periodic maintenance (US$241.2m) and routine maintenance (US$70.4m) of the total network, of which US$771.4 m or 83.4% should go to the national roads (Fundamental and complementary roads) and the remaining US$153.4m or 16.6% to the sub-national roads (unclassified/municipal roads). Once this rehabilitation backlog program is implemented during the first five years, in years 6 to 20, US$320.4 million per year is needed for preservation works on the entire network of which around 90% will be spent on routine and periodic maintenance work. The annualized net present value of road agency costs over the 20-year evaluation period, at 6% discount rate, is US$660.8 million/year.

Table 11: Two-lane Unit Costs of Road Works by surface type and condition

Years 1 to 5 Annual Road Works Costs (US$ million/year)					
Network	**Routine Maintenance**	**Periodic Maintenance**	**Rehabilitation**	**Total**	**Percent**
Fundamental	52.0	220.4	386.0	658.4	71.2
Complementary	9.1	8.7	95.2	113.0	12.2
Sub-Total/National	**61.1**	**229.1**	**481.2**	**771.4**	**83.4**

[11] RONET computes, for each road class and for different preservation standards, the present value of road agency costs, road user costs, and total transport costs (sum of road agency and road user costs); thus, the optimal standard per road class is the one that minimizes the present value of total transport costs.

Unclassified/Municipal	9.3	12.1	132.0	153.4	16.6
TOTAL	**70.4**	**241.2**	**613.2**	**924.8**	**100**
Percent	7.6	26.0	66.4	100	
Years 6 to 20 Annual Road Works Costs (US$ million/year)					
Network	**Routine maintenance**	**Periodic maintenance**	**Rehabilitation**	**Total**	**Percent**
Fundamental	49.6	195.2	32.5	277.3	86.5
Complementary	9.1	10.3	0.0	19.4	6.1
Sub-Total/National	**58.7**	**205.5**	**32.5**	**296.7**	**92.6**
Unclassified/Municipal	9.3	14.4	0.0	23.7	7.4
TOTAL	**68.0**	**219.9**	**32.5**	**320.4**	**100**
Percent	21.2	68.6	10.1	100	

Source: RONET

Angola's average annual road sector expenditure (US$2,231 billion) is nearly two and a half times (2.4 time) more than road rehabilitation and maintenance requirements (US$0.925 billion). The estimated annual cost needed to properly rehabilitate and maintain the national roads (US$771.4 million) is 2.67 less than the average annual budget allocations (US$2.06 billion) to national roads (2008-2017). The results also show that US$70.4 million/year are required to undertake routine maintenance interventions on the whole road network of which US$61.1 million will cover national roads and US$9.3 million the sub-national roads. The analysis of the BOOST database shows that only US$28.0 million, on average, are allocated each year to road maintenance work for the whole road network (2008-2018). This indicates that the budget allocations for road maintenance cover only 40% of the routine maintenance needs. As for the sub-national roads, an estimate of 153.4 million per year is needed to rehabilitate and maintain the municipal road network (33000km). This is less than the current average annual budget of US$171.0 million allocated each year through sub-national government to municipal roads. The average budget allocations exceed by 11% the road rehabilitation and maintenance requirements (Table 12).

Table 12: Comparison of actual expenditures and funding requirements (in US$ million/year)[12]

	Actual Expenditure	**Estimated Needs**
National road network (Fundamental & Complementary roads)	2,060.0	771.4
Sub-national (Unclassified/Municipal roads)	171.0	153.4
Total road network	2,231.0	924.8

Source: MINFI, RONET

[12] The RONET results (Appendix 1) compare actual revenue and estimated needs for funding gaps analysis. However, considering the weak relationship between revenues from road user charges and expenditure on road preservation in Angola, actual expenditure is used

Table 13 presents the annualized present value of road-agency, road-user and total transport costs over the next 20 years, at a 6% discount rate, for the "minimize transport costs" scenario and for a "do minimum" scenario. For the minimized total transport costs scenario, road user costs represent 89% of total transport costs. The increase in annualized present value of total transport costs of "do minimum "corresponds to US$5,462 million per year. Compared with "minimize total transport costs" scenario, for every dollar saved by the road agency under the" do minimum" scenario, road user costs increase by 3.4 times. This indicates that every US dollar spent on road maintenance will generate US$3.4 in road user cost saving.

Table 13: Annualized costs years 1 to 20

Minimize Transport Costs Scenario (Million US$/year)		
Road Agency	Road Users	Society
4,464	70,865	75,329
Do Minimum Scenario (M US$/year)		
Road Agency	Road Users	Society
3,226	76,547	79,772
Reduction in Costs Compared with Do Minimum (M US$/year)		
Road Agency	Road Users	Society
-2,260	7,723	5,462
Increase in Road User Costs per Decrease in Agency Costs		
	3.4 times	

***Source*: RONET**

In the 'minimize transport costs' scenario, the percentage of roads in good and fair condition will improve and the road roughness index will decrease from the current 15.3 to 8.4. However, under the "do minimum" scenario the share of roads in good and fair condition will decline as the roughness index will increase to 20.4. A situation where the road network will be barely passable (Table 14).

Table 14: Road condition per transport costs scenario

Minimize Transport Costs Scenario (Roughness Index)	
Current	2030
15.3	8.4
Do Minimum Scenario (Roughness Index)	
Current	2030
15.3	20.4

***Source*: RONET**

6 RECOMMENDATIONS

The Government of Angola recognizes the important role of road transport and, since the end of the civil war in 2002, has made transport infrastructure a key priority with ambitious targets to be achieved. In the last decade (2008-2018), budget expenditures have increased significantly and a total of around US$23.0 billion was allocated to the development of the road sector, but there is evidence that the efficiency of such spending could be substantially improved. The road expenditure level is three times higher than the outputs. The share of public expenditure on road maintenance is negligible and two-thirds of the road network is still in critical condition. Effective and efficient functioning of road transport infrastructure is central to accelerating Angola's economic development. The recommendations that follow are based on the findings of the public expenditure review of the sector and on the best practice principles governing successful commercialization of the road sector. Such change should be undertaken in a holistic and integrated manner with a clear vision of the objectives of the reform program and the strategies for its implementation.

Improve the road sector governance. The level of spending on national roads (Fundamental and complementary roads) is nearly two and a half times (2.4 time) more than the estimated road rehabilitation and maintenance requirements. This increase in spending has not been accompanied by commensurate increases in physical road output and condition. This has resulted in much higher average costs for both preservation and development works. This inefficiency cannot be explained by a lack of technical and management capacity alone but is likely due to issues with the road sector governance. While the current road sector institutional set up may be sound; with a separation of the policy (MINCON), management (INAE) and financing (Road Fund, 2015) functions it does not, however, seem to be implemented effectively. Recent changes in the structure of the organization that made both INAE and the Road Fund report to the same Ministry (MINCON) could be the first step to improve coordination. There is clearly a need to introduce more efficient and business-oriented road management practices and to improve financial and managerial accountability. Addressing these constraints through improvements in the organization of road management services will be necessary to gain efficiencies and cost reductions that can be passed on to road users. The Road Fund should fully play its role of mobilizing adequate revenues for road maintenance activities and to make sure the resources are used in efficient way.

Improve the effectiveness of the road fund. The road fund of Angola is established on a strong legal basis and on paper it meets all the second-generation road fund criteria. However, there are no implementing regulations for the road fund to effectively operate. The road fund revenues are still based on erratic budget allocations of only $US28.0m/year on average. This is half the required road maintenance needs of fundamental and complementary road network estimated at around $US59.0/year. The Road Fund should also validate the road maintenance programs and demand value for money by carrying out financial and comprehensive independent technical audits. The technical and financial auditing of maintenance projects is undertaken by most Road Funds, often on a sample basis, and has proved valuable in improving accountability by revealing the quality of the work done, the quantity of work completed and the timeliness of the work. Auditing should be undertaken for each stage of the project cycle from design to completion of works in order to ensure that Government and other stakeholders are receiving value for money.

Develop and sustain a road data base and asset management system. Description of the road network is scarce and unreliable. INAE has no road inventory database and does not carry out road condition and traffic surveys. Managing a road system in an optimal manner is a complex task that is likely to be influenced by a variety of factors including political. In such an environment, INAE will have to routinely face important policy questions from stakeholders as well as increasing demands upon the monies allocated by financing institutions (MoF, Road Fund). To address policy issues in a rationale manner, INAE would have to adopt an asset management approach using an appropriate road asset management system (RAMS). Data collection is expensive, and it is essential that the road agency only collects the data which are required for its management purposes. This data should be collected at a frequency and a level which is appropriate to make informed decisions on road planning and maintenance programs. INAE should consider contracting out the data collection, operation and upkeep of the RAMS to competent local consultants who would also be responsible for providing technical back-up. With such an arrangement, INAE would retain strategic responsibility for directing the evaluation of alternative strategies and developing programs for maintaining the road network in an optimum manner.

Review the road network classification to assert the ownership of the complementary roads (the missing middle) and of the unclassified roads. The functions and status of road networks in Angola are regulated by Decree 21/92 and 46/92 issued in 1992. The status classification is the most important since it determines responsibility for financing of works, but the mapping between functional and status classifications is undermined by flexible interpretation of the term 'strategic road'. The current classification does not adequately reflect the country's administrative and organization structure (decentralization levels). The focus is put on the fundamental road network (26000km) and little attention is given to the complementary roads (17000km) and to the municipal road network (33000km). The latter provides access for most of the population but is still an unclassified network. The ownership of the complementary road network, which provides the link between the arterial and the tertiary roads, is not clear, and the whole road network continuity and integration are becoming a challenge (the missing middle). There is a need to review the current road classification. The main objective is to identify the road links, their characteristics and the role each link plays within the entire road network. The criteria for classifying the various roads will include population density and land use and traffic volumes as the main critical variable. The functional classification system will provide a foundation for proper highway planning and fiscal policy.

Develop rural road development programs. Half of the population is located further than 2km from any road. Access of agriculture production to main markets is poor overall. almost three quarter of the total agriculture production value cannot reach markets, although this varies across provinces. Half of the population is located further than 2km from any road. Access to social services (health centers and schools) is overall poor, only 37% of the total population can access hospitals and schools in less than 2 hours. This indicates that there is a need to rehabilitate or build new municipal roads.

Establishment of road management agencies at provincial level. The level of spending on maintenance and rehabilitation is slightly higher than the estimated needs, but the municipal road network remains in critical condition. This is partly due to lack of management and technical capacity at subnational level. There are currently more than 182 entities responsible for sub-national road maintenance (18 provinces and 164 municipalities), making it very difficult for a coordinated approach to address the maintenance backlog. A road maintenance demonstration project could be considered by establishing a semi-

autonomous provincial road agency to strategically plan and manage the extended sub-national road network. In addition to the provincial roads under the responsibility of the respective province based on the results of a road work reclassification, municipalities could delegate the management of all or part of their road networks using a contract management approach. The implementation could be tested through a demonstration project. The objectives of such a new institutional arrangement would be to increase regional coordination, take advantage of economies of scale and improve the effectiveness and efficiency of public expenditure. The proposal also addresses the technical and managerial capacity issue without undermining local decision-making authority. This institutional set up has been widely used with success in several countries in Latin America (Box 1). The new provincial road agency should not be perceived as a parallel institution to the existing arrangements. The personnel of the provincial road agency would be established from the existing Public Works staff who are currently managing province and local government roads. Representatives of the provinces and municipalities would form an oversight board for the agency. The board would advise on the planning, budget allocation and management of the road network.

Box 1: Peru Provincial Road Institutes

Peru has experienced a decentralization process in 2002. As a result, a three-tier structure is now in place with 24 elected regional governments and 2,006 municipalities (194 provinces and 1,812 districts). The World Bank and the Inter-American Development Bank have supported a substantial change in the decentralized management of sub-national roads. The first rural road project in Peru has helped establish the first decentralized "provincial road institute" which are now established in every province.

The Provincial Road Institute mandate is to design and implement province-wide road strategies that provide an effective means to coordinate between districts and local government, private sector providers and local communities. The Provincial Road Institute helped overcome weak financial and administrative capacity in districts to maintain roads. The Project has resulted in the rehabilitation of 15,000 km of district roads and 2,700 km of provincial roads. The proportion of the current sub-national roads in good condition has nearly doubled. Various studies show substantial positive impact of the improved roads, including reduction in average travel time by 50 percent, a 78 percent reduction in passenger travel fares, 18 percent in freight cost and an increased access to education. The project concept is being currently extended to cover other infrastructure sectors (water and sanitation, rural electricity) and health.

Source: World Bank

Support the development of a competitive road contractors' industry. It will be useful to carry out a study pf the current road construction industry to have a better understanding of the road contracting market, and to identify priority measures to address any constraints to its development. The performance of local contractors is viewed by many roads agencies as source of concern. However, there are often mitigating reasons for this which have been recognised in most countries where serious efforts are being made to improve the local contracting industry. Roads agencies and other stakeholders, such as national construction industry councils, should be encouraged to promote measures for improving local contracting capacity, including plant and equipment leasing and/or financing, use of multi-year rather than single year contracts and appropriate packaging of contracts into manageable sizes.

7 APPENDIXES

7.1 APPENDIX 1: ROAD ACCESSIBILITY ANALYSIS TO MARKETS, EDUCATION AND HEALTH

This Appendix presents the results of the accessibility analysis to markets, education and health facilities in Angola. The analysis aims to build an understanding about the role of roads in the rural economic and the human capital development. This Appendix includes the following sections.

(i) Access to agriculture markets: This section assesses the ability of agriculture production by value to access markets and identifies regions in Angola where access to markets for agriculture production is limited

(ii) Access to social services: This section assesses the ability of people to reach schools and hospital and identifies people with different level of access.

The analysis is rooted on geospatial modelling and the concept of accessibility to point of interest to capture indicators linked to two dimensions: (i) economic growth: analyzing data on agriculture production value and location of regional markets to assess the accessibility of rural farmers to regional markets, as a key indicator to foster economic growth in rural areas; and (ii) human capital development: analyzing the accessibility of population to critical social services such as schools and hospitals.

The method uses a geospatial database that includes road network and location of specific points of interest (agriculture, markets, schools, health centers). The data utilized is mainly open data available from different data sources. It worth indicating the limitation to verify this open data. The data sources are:

- **Population:** WorldPop, 2015 estimates of people per grid square, Resolution 0.000833333 decimal degrees (approx.. 100m at the equator)
- **Points of Interest (POI):** Hospitals, Schools location from Open Street Map. Markets locations: considered cities with more than 30,000 people (Africapolis), where main markets are located

Road Network: *Open Street Map (Figure 1: Road network, Source: OSM*

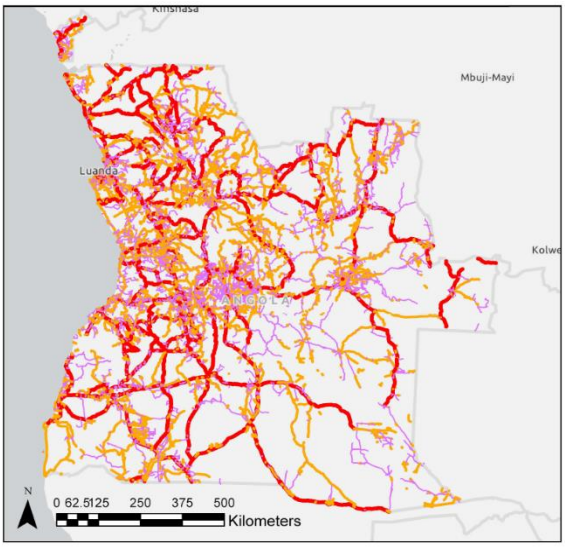


Figure 1: Road network, Source: OSM

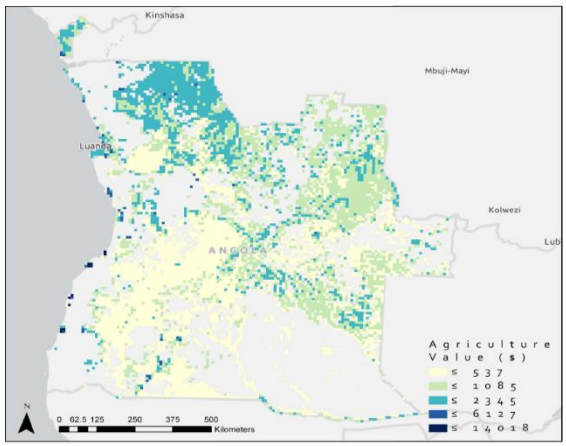


Figure 2: Value of crop production (2010), Source: SAPM

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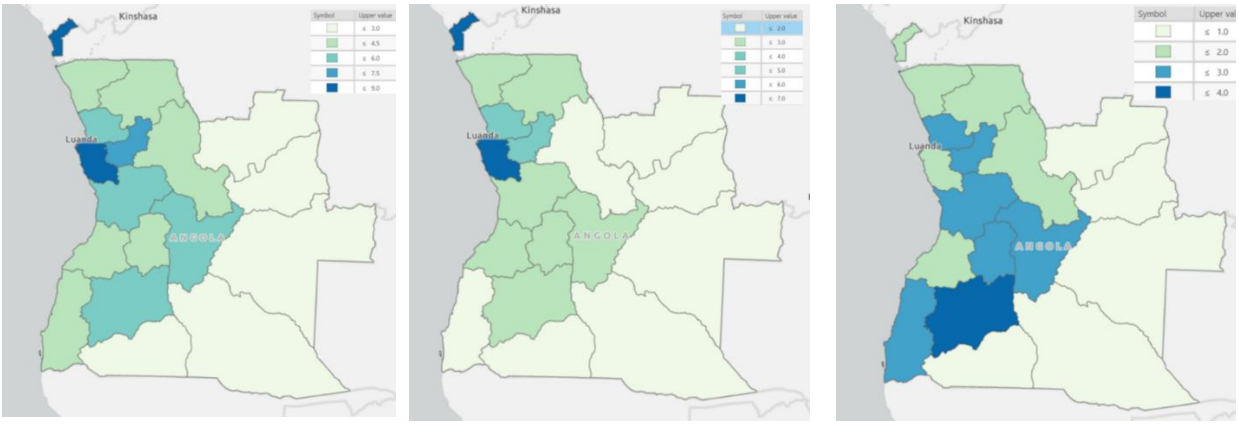
- **Agriculture:** Value of Crop Production (2010) at 10km resolution – *International Food Policy Research Institute (IFPRI) SPAM model (*Figure 2: Value of crop production (2010), Source: SAPM

- *)*

National roads density (fundamental + complementary) (km/100km^2)

Fundamental road density (km/100km^2)

Complementary road density (km/100km^2)



National roads (fundamental + complementary)
Km per 1000 people (km/1000 inhabitant)

Fundamental roads
Km per 1000 people (km/1000 inhabitant)

Complementary roads
Km per 1000 people (km/1000 inhabitant)

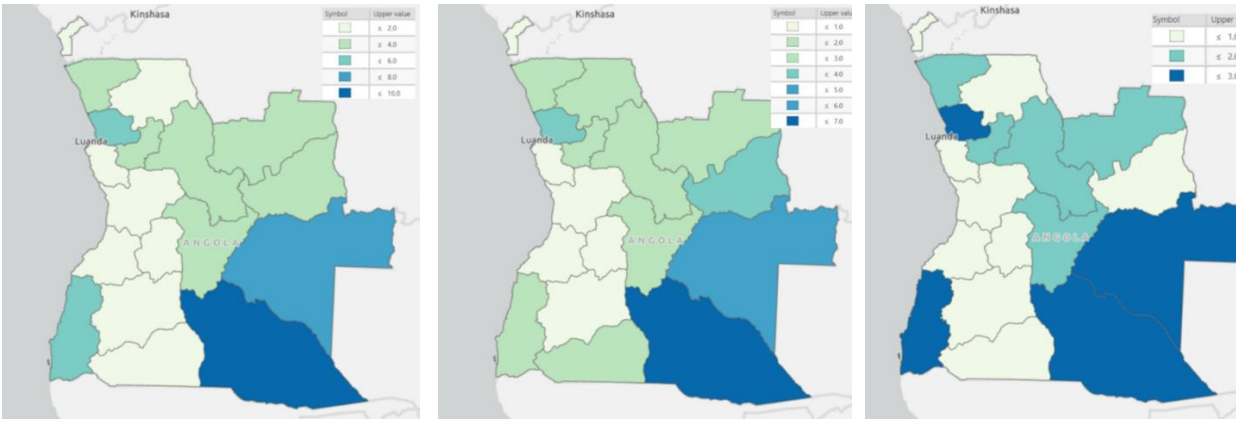


Figure 3: Road density by province

Agriculture products access to markets

Agriculture production value is predominant in the north and east of Angola. There are five provinces - Moxico Uige, Luanda Sul, Malanje and Luanda Norte – that account for two thirds of the total agriculture value of Angola. *Figure 4: % of agriculture value per province*

and *Figure 5: % of agriculture value per province*

present the distribution of the agriculture production value per province.

Figure 4: % of agriculture value per province

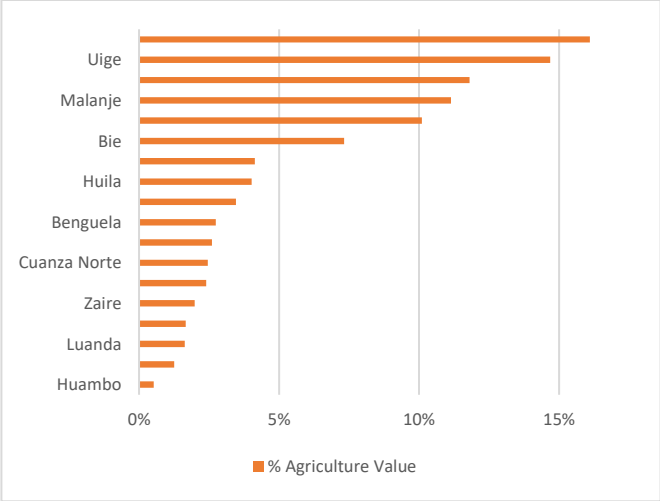
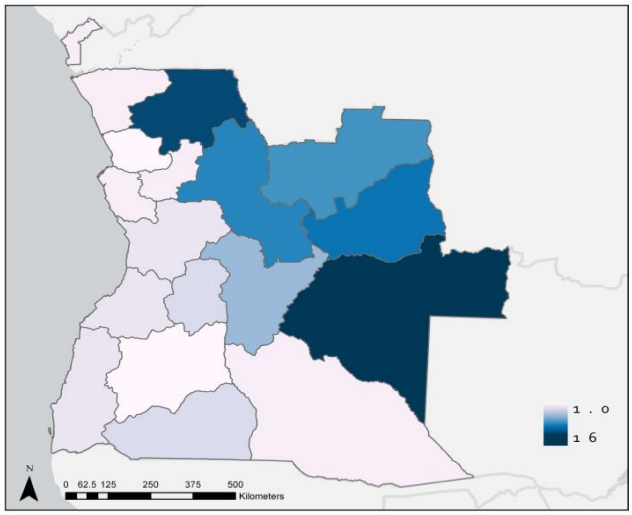


Figure 5: % of agriculture value per province

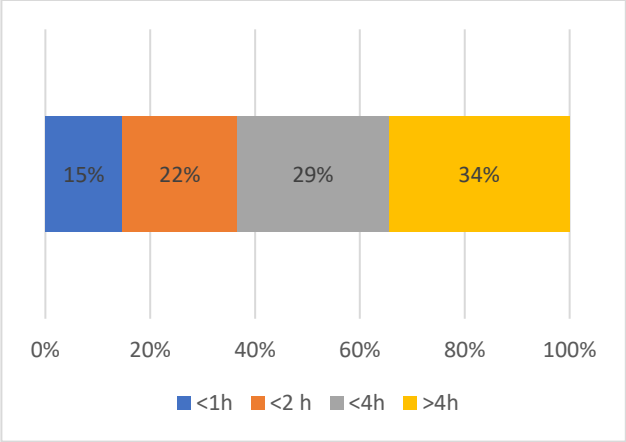


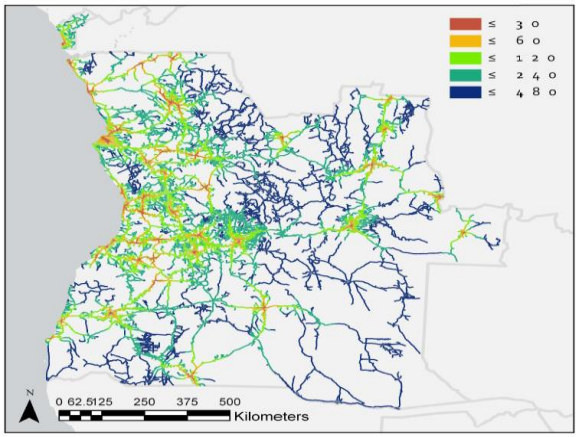
The access of agriculture production to main markets is in overall poor, almost three fourths of the total agriculture production value cannot reach markets. Of the overall agriculture production value, 71 percent cannot reach markets[13]. Out of the 29 percent of the agriculture production value that can reach markets, only 37 percent of value can reach markets in less than 2 hours.

Figure 6: % of agriculture production value that reach the main markets under time thresholds

Figure 7: Accessibility to markets –Minutes to the closest market

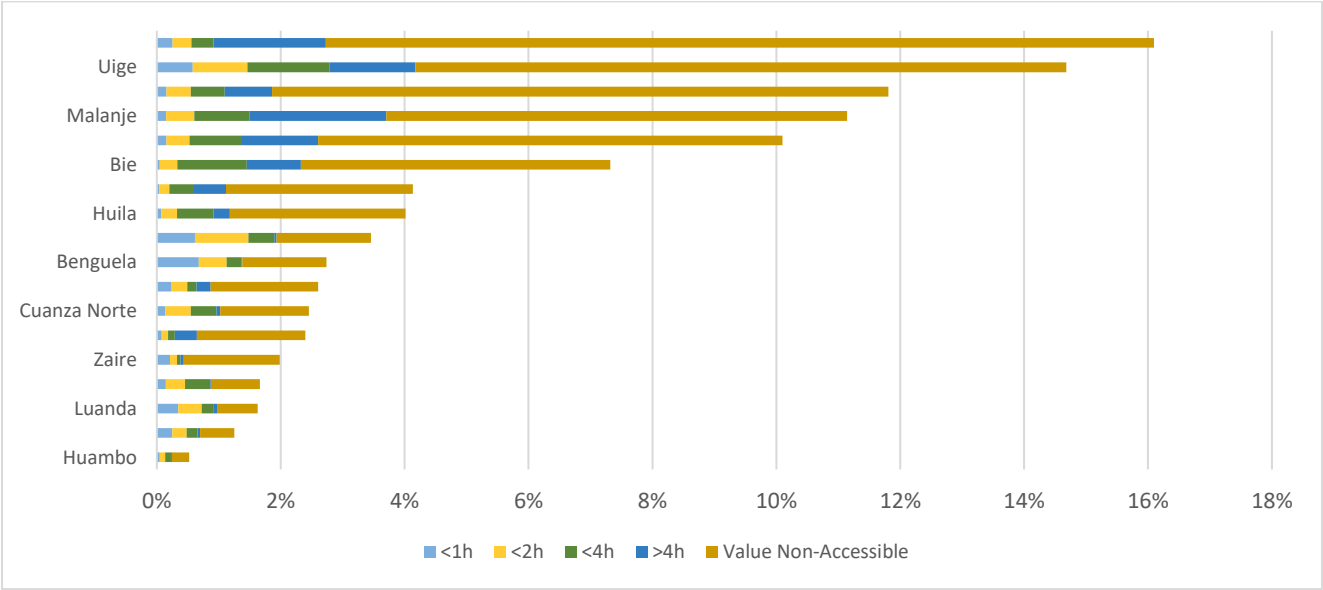
[13] The analysis considers the agriculture production within a buffer of 2 km around all classified and unclassified roads can reach markets





A significant part of the agriculture value in the top five provinces that account for two thirds of the national value does not have access to markets. The distribution of access to markets varies per province (Figure 8). Although Moxico has the largest agriculture production value of around 16 percent of the national value, it does not have the highest value accessible to markets because 83 percent of its value is not accessible. Uige and Malanje have the highest agriculture value accessible to markets, that represents around 4 percent of Angola agriculture value per province. Uige and Cuanza Sul are the provinces where the highest agriculture production can reach markets in less than 2 hours. Figure 8 presents the distribution of the agriculture production value, as a percentage of the national agriculture production value

Figure 8: Distribution of the agriculture production value, as a percentage of the national agriculture production value by time thresholds and non-accessible



Access to social services

Access to social services is overall poor, both in the access to hospitals and schools. Around half of the country's population does not have hospitals[14] and only 37 percent can access hospitals in less than 2

[14] The analysis considers population within a buffer of 2 km around all classified and unclassified roads can access facilities

hours. The access to schools follows similar trends. These values offer a general understanding of the access issues to social services; however, limitations should be acknowledged of the data of schools and hospital location (from Open Street Map). It is therefore recommended that further analysis should be carried out using more accurate data.

Figure 9: Accessibility to hospitals – time to reach closest hospital (min)

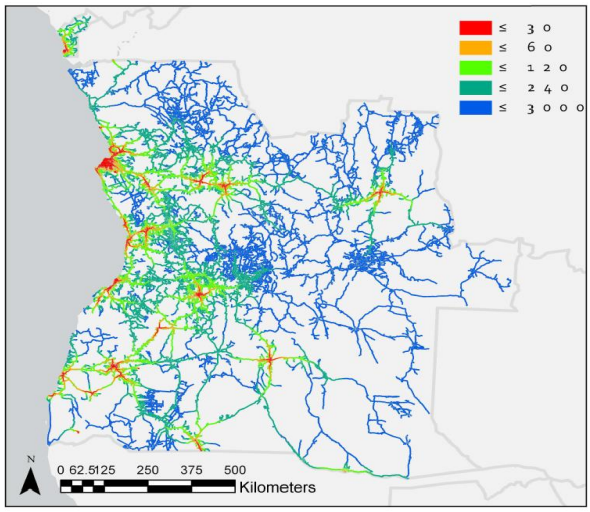


Figure 10: Distribution of the population within thresholds of time to access hospitals

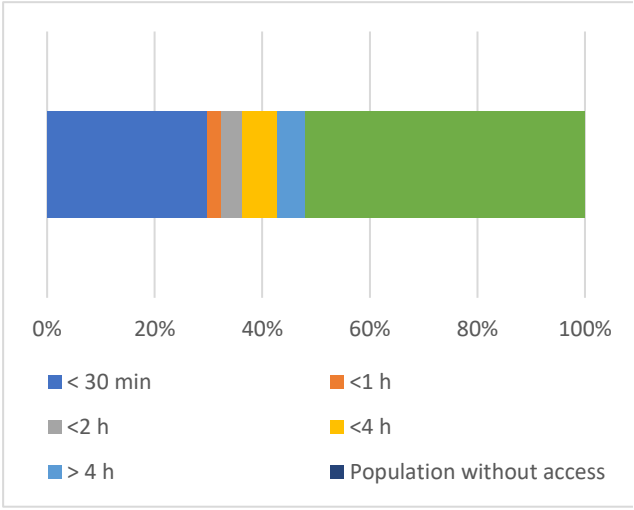


Figure 11: Accessibility to schools – time to reach closest school (min)

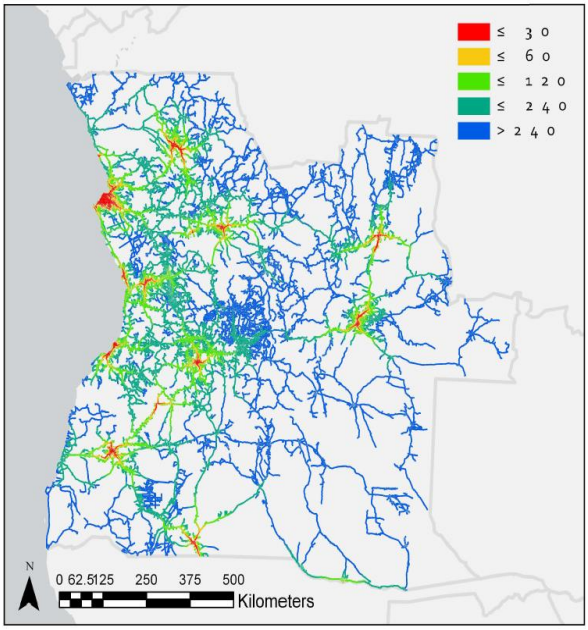
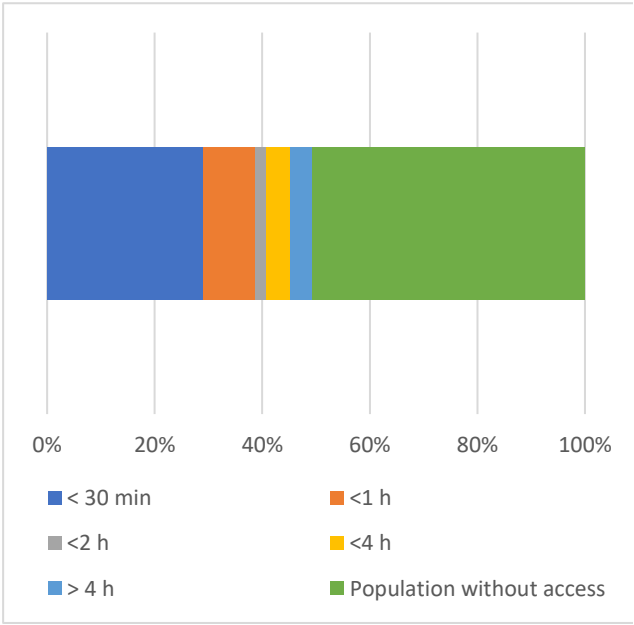


Figure 12: Distribution of the population within thresholds of time to access schools



7.2 APPENDIX 2: ANGOLA RONET EVALUATION

Input Data Assumptions

Unit Cost of road Works

Used **twice** the default unit costs given on RONET resulting on the following unit costs per km for a two-lane road for capital works and recurrent maintenance works:

Capital Road Works Unit Costs

		Two-lane Unit Costs of Road Works ($/km)		
Surface Type	Current Condition	Road Work Class	Road Work Type	($/km)
Asphalt Mix	Good Condition	Periodic Maintenance	Preventive Treatment	24,000
	Fair Condition		Resurfacing (Overlay)	200,000
	Poor Condition	Rehabilitation	Strengthening (Overlay)	400,000
	Very Poor Condition		Reconstruction	660,000
	No Road	New Construction	New Construction	800,000
Surface t Treatment	Good Condition	Periodic Maintenance	Preventive Treatment	24,000
	Fair Condition		Resurfacing (Reseal)	54,000
	Poor Condition	Rehabilitation	Strengthening (Overlay)	320,000
	Very Poor Condition		Reconstruction	520,000
	No Road	New Construction	New Construction	660,000
Gravel	Good Condition	Periodic Maintenance	Spot Regravelling	6,000
	Fair Condition		Regravelling	34,000
	Poor Condition	Rehabilitation	Partial Reconstruction	80,000
	Very Poor Condition		Full Reconstruction	120,000
	No Road	New Construction	New Construction	160,000
Earth	Good Condition	Periodic Maintenance	Spot Repairs	400
	Fair Condition		Heavy Grading	1,600
	Poor Condition	Rehabilitation	Partial Reconstruction	16,000
	Very Poor Condition		Full Reconstruction	50,000
	No Road	New Construction	New Construction	80,000

Recurrent Maintenance Works Unit Costs

		Two-Lane Unit Costs of Road Works ($/km-year)				
Surface Type	Road Condition	F. Paved	F. Unpaved	Tertiary	Urban	Unclassified
Cement Concrete	Very Good	4,000	4,000	4,000	2,000	2,000
	Good	5,000	5,000	5,000	2,500	2,500
	Fair	6,000	6,000	6,000	3,000	3,000
	Poor	3,000	3,000	3,000	1,500	1,500
	Very Poor	3,000	3,000	3,000	1,500	1,500
Asphalt Mix	Very Good	4,000	4,000	4,000	2,000	2,000
	Good	5,000	5,000	5,000	2,500	2,500
	Fair	6,000	6,000	6,000	3,000	3,000
	Poor	3,000	3,000	3,000	1,500	1,500

	Very Poor	3,000	3,000	3,000	1,500	1,500
Surface Treatment	Very Good	4,000	4,000	4,000	2,000	2,000
	Good	5,000	5,000	5,000	2,500	2,500
	Fair	6,000	6,000	6,000	3,000	3,000
	Poor	3,000	3,000	3,000	1,500	1,500
	Very Poor	3,000	3,000	3,000	1,500	1,500
Gravel	Very Good	2,000	2,000	2,000	1,000	1,000
	Good	2,500	2,500	2,500	1,252	1,252
	Fair	3,000	3,000	3,000	1,500	1,500
	Poor	1,500	1,500	1,500	750	750
	Very Poor	1,500	1,500	1,500	750	750
Earth	Very Good	600	600	600	300	300
	Good	900	900	900	450	450
	Fair	1,200	1,200	1,200	600	600
	Poor	600	600	600	300	300
	Very Poor	600	600	600	300	300

Vehicle Fleet Basic Characteristics and Unit Costs

Used the default RONET vehicle fleet characteristics and unit costs

Traffic Composition

Based on the traffic composition given on the AfDB report.

Motorcycle	42%
Car Small	0%
Car Medium	34%
Delivery Vehicle	7%
Four-Wheel Drive	0%
Truck Light	4%
Truck Medium	2%
Truck Heavy	2%
Truck Articulated	5%
Bus Light	1%
Bus Medium	2%
Bus Heavy	1%

Traffic Growth Rate

Based on the employment forecast given on the AfDB report (3% per year). For all vehicles, 3 % traffic growth per year was adopted.

Road Network Length

The AfDB indicates that the fundamental network totals 26,000 km. The CIA factbook indicates that in 2018 in Angola there are 13,600 km of paved roads and 12,400 of unpaved roads (totaling 26,000 km). There is a total of around 76,000 km in the country, of which around 17,000 km are complementary roads. Thus, we evaluated the following road networks in RONET:

Fundamental Paved Roads (13,600 km)

Fundamental Unpaved Roads (12,400 km)

Complementary Roads (17,000 km)

Unclassified Roads (33,000 km)

Total (76,000 km)

We assumed that the fundamental unpaved roads are gravel roads and the complementary and unclassified roads are earth roads. We assumed that the paved roads with less than 1,000 vehicles per day are surface treatment roads, while roads with more than 1,000 per day are asphalt concrete roads.

Road Network Traffic

The AfDB report presents the traffic counted on 30 points on the main roads. There is no traffic data per road section. I computed the histogram of the traffic given on the 30 traffic counting points and got the following histogram. We used the results of the histogram to subdivide the paved roads by traffic ranges.

Daily Traffic (AADT) From	To	Fundamental Paved (%)	Fundamental and complementary Unpaved %	Unclassified Municipal %
0	10	0%	0%	0%
10	30	0%	0%	25%
30	100	3%	25%	50%
100	300	27%	50%	25%
300	1000	23%	25%	0%
1000	3000	37%	0%	0%
3000	10000	10%	0%	0%
10000	30000	0%	0%	0%
30000	100000	0%	0%	0%

For gravel roads (fundamental unpaved network), I use the following percentages to subdivide the gravel roads by traffic ranges

Traffic (AADT) Range	Percent (%)
<30	0%
30-100	25%
100-300	50%
300-1000	25%
>1000	0%

For earth roads (tertiary network), We use the following percentages to subdivide the earth roads by traffic ranges

Traffic (AADT) Range	Percent (%)
<10	0%
10-30	25%
30-100	50%
100-300	25%
>300	0%

Road Network Condition

The Excel file received with the road network data has data for 19,037 km summarized below.

Road Number	Paved	Unpaved	Total
100	1,301	301	1,602
105	492		492
110	423	468	891
120	926	519	1,445
140	1,166	268	1,434
160	238	1,464	1,702
170		1,471	1,471
180	1,041	269	1,310
190		795	795
195		247	247
210	291	183	474
220	277	159	436
225	1,009		1,009
230	1,170		1,170
240	849		849
245	224		224
250	1,305		1,305
260	912		912
280	1,269		1,269
Total	12,893	6,144	19,037

The Excel file has road condition data for 9,885 km of paved roads (there are 3,008 km of paved roads with no condition data). It is not clear the year of the road condition data. The road condition data available is given on the table below.

	Paved Roads							Unpaved	
Province	Very Good	Good	Fair	Poor	Very Poor	No data	Total	Roads	Total
Bengo			253				253	159	412
Benguela		403	136	262			801	252	1,053
Bíe		284		213	214	112	823	118	941
Cabinda							0	116	116
Cuando Cubango		77				536	613	1,451	2,064
Cuanza Norte		90	263	134			487		487
Cuanza Sul		241	705	123	0		1,069	103	1,172
Cunene		37	117				154	332	486
Huambo		183	332			99	614	0	614

Huíla		789	208				997	195	1,192
Luanda			184	155			339		339
Luanda Norte					247		247		247
Lunda Norte			165				165	289	454
Lunda Sul			281	292		584	1,157	442	1,599
Malange		314		95		444	853	638	1,491
Moxico		975	80			1,233	2,288	1,576	3,864
Namibe		386					386	185	571
Uíge		247	515		146		908	288	1,196
Zaire	226		291		222		739		739
Total	226	4,026	3,530	1,274	829	3,008	12,893	6,144	19,037

We used this knowledge to subdivide the paved road network per road condition classes assuming the same percentages as the ones for the 9,885 km with road condition data. Thus, we have for the 13,600 km paved roads

Very Good	2%
Good	41%
Fair	36%
Poor	13%
Very Poor	8%

We don't have road condition data for the gravel roads, Thus, I assumed the following for the 12,400 km of gravel roads.

Very Good	0%
Good	15%
Fair	25%
Poor	35%
Very Poor	25%

We don't have road condition data for the earth roads, Thus, I assumed the following for the 50,000 km of complementary and unclassified earth roads.

Very Good	0%
Good	5%
Fair	15%
Poor	45%
Very Poor	35%

These assumption yield for the fundamental network (paved and gravel) a total of 40% in poor or very poor condition. The AfDB report indicates that 45% of the national roads are in critical or bad condition (I assume that national roads refer to the fundamental network). We have the following for the fundamental network of 26,000 km:

Very Good	1%
Good	29%

Fair	31%
Poor	23%
Very Poor	16%

These assumption yield for the total network a total of 60% in poor or very poor condition. We have the following for the total road network of 76,000 km:

Very Good	0%
Good	13%
Fair	20%
Poor	38%
Very Poor	28%

Road Network Condition and Traffic

RONET requires to know the distribution of the road network length per road condition and traffic level combined. For Angola, we have the assumed distribution of the road network length per road condition separate from per traffic level. Thus, to use RONET in Angola, an important simplification was done that assumes the same traffic distribution applies for each road condition class. Thus, we have the following network evaluated with RONET.

Fundamental Paved

Asphalt Mix

Condition (IRI) / Traffic (AADT)		Very Good 2	Good 3	Fair 4.5	Poor 8	Very Poor 12	Total
Traffic I	<300	0.0	0.0	0.0	0.0	0.0	0.0
Traffic II	300-1000	0.0	0.0	0.0	0.0	0.0	0.0
Traffic III	1000-3000	100.6	2,063.1	1,811.5	654.2	402.6	5,032.0
Traffic IV	3000-10000	27.2	557.6	489.6	176.8	108.8	1,360.0
Traffic V	>10000	0.0	0.0	0.0	0.0	0.0	0.0
Total		127.8	2,620.7	2,301.1	831.0	511.4	6,392.0

Fundamental Paved

Surface Treatment

Condition (IRI) / Traffic (AADT)		Very Good 3	Good 4	Fair 5.5	Poor 9	Very Poor 13	Total
Traffic I	<300	81.6	1,672.8	1,468.8	530.4	326.4	4,080.0
Traffic II	300-1000	62.6	1,282.5	1,126.1	406.6	250.2	3,128.0
Traffic III	1000-3000	0.0	0.0	0.0	0.0	0.0	0.0
Traffic IV	3000-10000	0.0	0.0	0.0	0.0	0.0	0.0
Traffic V	>10000	0.0	0.0	0.0	0.0	0.0	0.0
Total		144.2	2,955.3	2,594.9	937.0	576.6	7,208.0

Fundamental Unpaved

Gravel

Traffic (AADT) \ Condition (IRI)		Very Good	Good	Fair	Poor	Very Poor	Total
		5	7	11	16	20	
Traffic I	<30	0.0	0.0	0.0	0.0	0.0	0.0
Traffic II	30-100	0.0	465.0	775.0	1,085.0	775.0	3,100.0
Traffic III	100-300	0.0	930.0	1,550.0	2,170.0	1,550.0	6,200.0
Traffic IV	300-1000	0.0	465.0	775.0	1,085.0	775.0	3,100.0
Traffic V	>1000	0.0	0.0	0.0	0.0	0.0	0.0
Total		0.0	1,860.0	3,100.0	4,340.0	3,100.0	12,400.0

Complementary and Unclassified

Earth

Traffic (AADT) \ Condition (IRI)		Very Good	Good	Fair	Poor	Very Poor	Total
		7	9	13	18	22	
Traffic I	<10	0.0	0.0	0.0	0.0	0.0	0.0
Traffic II	10-30	0.0	625.0	1,875.0	5,625.0	4,375.0	12,500.0
Traffic III	30-100	0.0	1,250.0	3,750.0	11,250.0	8,750.0	25,000.0
Traffic IV	100-300	0.0	625.0	1,875.0	5,625.0	4,375.0	12,500.0
Traffic V	>300	0.0	0.0	0.0	0.0	0.0	0.0
Total		0.0	2,500.0	7,500.0	22,500.0	17,500.0	50,000.0

RONET Results

Network Monitoring Indicators

The resulting network monitoring indicators are given below.

Network Monitoring Indicators

Monitoring Indicator		F. Paved	F. Unpaved	Complementary	Unclassified	Overall
Network Length						
Road network length	km	13,600	12,400	17,000	33,000	76,000
Road network length that is unpaved	km		12,400	17,000	33,000	62,400
Road network length that is paved	km	13,600				13,600
Road network length that is paved	%	100.0%				17.9%
Network Density						
Road network per thousand land area	km/1000 sq km	10.91	9.95	13.64	26.47	60.96
Road network per thousand total population	km/1000 persons	0.45	0.41	0.56	1.09	2.50
Road network per thousand rural population	km/1000 persons	0.81	0.74	1.01	1.97	4.54
Road network per thousand vehicles	km/1000 vehicles	17.00	15.50	21.25	41.25	95.00
Road network per $ million GDP	km/million $	0.13	0.12	0.16	0.31	0.72
Paved road network per thousand land area	km/1000 sq km	10.91				10.91
Paved road network per thousand total population	km/1000 persons	0.45				0.45
Paved road network per thousand rural population	km/1000 persons	0.81				0.81
Paved road network per thousand vehicles	km/1000 vehicles	17.00				17.00
Paved road network per $ million GDP	km/million $	0.13				0.13
Network Condition						
Percentage of road network in good and fair condition	%	79.0%	40.0%	20.0%	20.0%	33.8%
Percentage of unpaved road network in good and fair condition	%		40.0%	20.0%	20.0%	24.0%
Percentage of paved road network in good and fair condition	%	79.0%				79.0%
Percentage of paved road network with roughness 4 m/km IRI or less	%	43.0%				43.0%
Paved roads average roughness weighted by km	IRI, m/km	5.42				5.42
Paved roads average roughness weighted by vehicle-km	IRI, m/km	5.46				5.46
Network Access						
Percentage of unpaved roads that are all-weather roads	%		40.0%			7.9%
All-weather roads area of influence (4 km wide) as a share of per land area	%		1.6%			6.0%
Network Standards						
Percentage of unpaved roads with 30 AADT or less	%			25.0%		6.8%
Percentage of unpaved roads with 300 AADT or more	%		25.0%		25.0%	18.2%
Percentage of paved roads with 300 AADT or less	%	30.0%				30.0%
Percentage of paved roads with 10,000 AADT or more	%	0.8%				0.8%
Network Utilization						
Annual motorized vehicle utilization	million vehicle-km	8,476	1,262	543	2,951	13,232
Annual freight carried over road network	million ton-km	15,939	2,372	1,021	5,549	24,882
Annual passengers carried over road network	million pass-km	30,259	4,504	1,938	10,535	47,237
Average network annual average daily traffic	vehicles/day	1,708	279	88	245	477
Network Safety						
Annual number of fatalities	persons	848	126	54	295	1,323
Annual number of serious injuries	persons	8,476	1,262	543	2,951	13,232
Annual number of casualties	persons	9,324	1,388	597	3,246	14,555
Annual casualties cost	million $	723	107.68	46.34	251.87	1,129.32
Annual casualties cost as a share of GDP	%	0	0.1%	0.0%	0.2%	1.1%
Annual number of fatalities per total population	#/100,000 persons	3	0.42	0.18	0.97	4.36
Network Asset						
Current road asset value	million $	7,867.1	1,148.2	935.7	1,297.4	11,248.4
Current road asset value as a share of maximum road asset value	%	79.7%	57.9%	68.8%	68.8%	74.5%
Current road asset value as a share of GPD	%	7.4%	1.1%	0.9%	1.2%	10.6%

Evaluation of Paved Fundamental Road Network (13,600 km)

Paved Network Required Expenditures Without Budget Constraints (Optimal Scenario)

The table below presents the required expenditures without budget constraints over the next five years and in years 6 to 20, in US$ million, for the paved fundamental network of 13,600km.

Optimal Scenario

Years 1-5

Road Agency Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	2,267.0	0.0	2,267.0	100%
F. Unpaved	0.0	0.0	0.0	0%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	2,267.0	0.0	2,267.0	100%
Percent	100%	0%	100%	

Rehabilitation Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	1,185.8	0.0	1,185.8	100%
F. Unpaved	0.0	0.0	0.0	0%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	1,185.8	0.0	1,185.8	100%
Percent	100%	0%	100%	

Periodic Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	933.7	0.0	933.7	100%
F. Unpaved	0.0	0.0	0.0	0%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	933.7	0.0	933.7	100%
Percent	100%	0%	100%	

Recurrent Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	147.5	0.0	147.5	100%
F. Unpaved	0.0	0.0	0.0	0%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	147.5	0.0	147.5	100%
Percent	100%	0%	100%	

Years 6-20

Road Agency Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	2,373.8	0.0	2,373.8	100%
F. Unpaved	0.0	0.0	0.0	0%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	2,373.8	0.0	2,373.8	100%
Percent	100%	0%	100%	

Rehabilitation Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	487.3	0.0	487.3	100%
F. Unpaved	0.0	0.0	0.0	0%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	487.3	0.0	487.3	100%
Percent	100%	0%	100%	

Periodic Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	1,479.7	0.0	1,479.7	100%
F. Unpaved	0.0	0.0	0.0	0%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	1,479.7	0.0	1,479.7	100%
Percent	100%	0%	100%	

Recurrent Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	406.9	0.0	406.9	100%
F. Unpaved	0.0	0.0	0.0	0%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	406.9	0.0	406.9	100%
Percent	100%	0%	100%	

The table below presents the required expenditures without budget constraints over the next five years and in years 6 to 20, in US$ million per year. Over the next five years, US$ 453 million per years is needed for rehabilitation, periodic maintenance and routine maintenance of the paved network. For rehabilitation works US$ 237.2 million per year is needed. For periodic maintenance works US$ 186.7 million per year is needed. For recurrent maintenance works US$ 29.5 million per year is needed.

Optimal Scenario

Years 1-5

Road Agency Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	453.4	0.0	453.4	100%
F. Unpaved	0.0	0.0	0.0	0%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	453.4	0.0	453.4	100%
Percent	100%	0%	100%	

Rehabilitation Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	237.2	0.0	237.2	100%
F. Unpaved	0.0	0.0	0.0	0%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	237.2	0.0	237.2	100%
Percent	100%	0%	100%	

Periodic Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	186.7	0.0	186.7	100%
F. Unpaved	0.0	0.0	0.0	0%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	186.7	0.0	186.7	100%
Percent	100%	0%	100%	

Recurrent Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	29.5	0.0	29.5	100%
F. Unpaved	0.0	0.0	0.0	0%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	29.5	0.0	29.5	100%
Percent	100%	0%	100%	

Years 6-20

Road Agency Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	158.3	0.0	158.3	100%
F. Unpaved	0.0	0.0	0.0	0%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	158.3	0.0	158.3	100%
Percent	100%	0%	100%	

Rehabilitation Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	32.5	0.0	32.5	100%
F. Unpaved	0.0	0.0	0.0	0%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	32.5	0.0	32.5	100%
Percent	100%	0%	100%	

Periodic Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	98.6	0.0	98.6	100%
F. Unpaved	0.0	0.0	0.0	0%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	98.6	0.0	98.6	100%
Percent	100%	0%	100%	

Recurrent Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	27.1	0.0	27.1	100%
F. Unpaved	0.0	0.0	0.0	0%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	27.1	0.0	27.1	100%
Percent	100%	0%	100%	

Paved Network Comparison of Budget Scenarios

The table below presents the rehabilitation, periodic maintenance and routine maintenance needs over the next five years, in US$ million per year, of the different budget scenarios evaluated. Scenarios Optimal +1 and Optimal +2 require more expenditures than the optimal scenario, which maximizes the network NPV. The other scenarios represent different levels of budget constraints.

Annual Road Agency Costs Years 1-5 (Annual Costs Years 1-5)

Network	Scenario	Annual Costs Years 1-5, M$/year			
		Rehabilitation	Periodic Maint.	Recurrent Maint.	Road Agency
Total Network	Optimal +2	334.6	244.5	52.4	631.5
	Optimal +1	279.4	244.5	48.1	572.0
	Optimal	237.2	186.7	29.5	453.4
	Optimal -1	237.2	19.6	25.7	282.4
	Optimal -2	150.8	19.6	18.2	188.5
	Optimal -3	150.8	0.0	17.2	168.1
	Do Minimum	127.5	0.0	16.4	143.9
	Do Nothing	0.0	0.0	0.0	0.0
	Custom	334.6	243.0	60.3	637.9

The table below show the comparison of the budget scenarios in terms of present value of agency costs at 6% discount rate.

Present Value of Society Costs

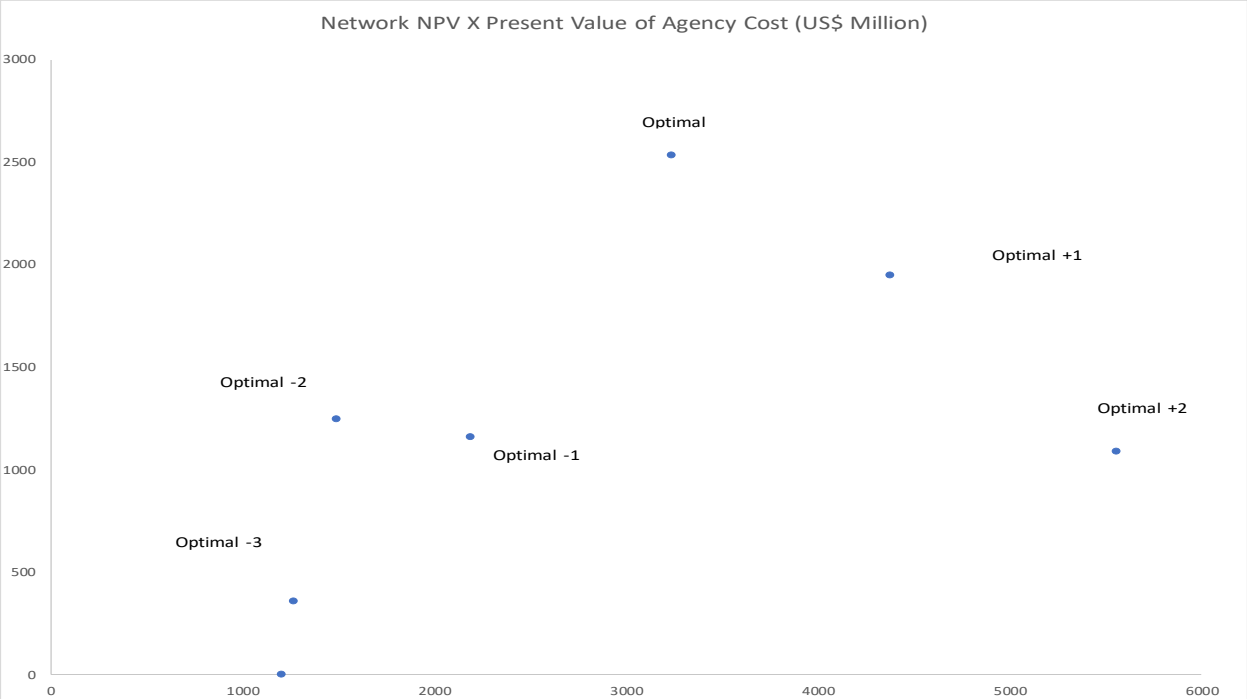
Network	Scenario	Present Value Years 1 to 20 at 6 percent (M$)		
		Road Agency	Road Users	Society
Total Network	Optimal +2	5,560	37,908	43,468
	Optimal +1	4,375	38,235	42,610
	Optimal	3,236	38,788	42,024
	Optimal -1	2,190	41,208	43,397
	Optimal -2	1,490	41,819	43,309
	Optimal -3	1,265	42,935	44,200
	Do Minimum	1,202	43,354	44,556
	Do Nothing	0	45,995	45,995
	Custom	5,451	38,127	43,578

The table below show the resulting NPV of the different budget scenarios.

Present Value Society Net Benefits Compared to Do Minimum Standard (NPV)

Network	Scenario	Society Costs (M$)	Net Benefit (M$)	Net Benefit (M$/year)
Total Network	Optimal +2	43,468	1,087	54.4
	Optimal +1	42,610	1,946	97.3
	Optimal	42,024	2,532	126.6
	Optimal -1	43,397	1,159	57.9
	Optimal -2	43,309	1,247	62.3
	Optimal -3	44,200	355	17.8
	Do Minimum	44,556	0	0.0
	Do Nothing	45,995	-1,439	-71.9
	Custom	43,578	978	48.9

A chart of the network NPV compared to the present value of agency costs of the different budget scenarios is given below.



The table below show the average roughness of the network under the different budget scenario. The Optimal scenario will keep the network at around the same condition as today at around 5.2 IRI for the next 10 years. The budget constraints scenarios will increase the average network roughness.

Roughness Weighted by Km

Network	Scenario	Roughness by Km (IRI, mm/km)			
		Current	Year 5	Year 10	Year 20
Total Network	Optimal +2	5.4	3.9	4.4	2.8
	Optimal +1	5.4	4.2	4.5	5.2
	Optimal	5.4	4.6	5.2	6.8
	Optimal -1	5.4	5.1	6.5	7.8
	Optimal -2	5.4	5.5	6.5	9.2
	Optimal -3	5.4	5.6	7.1	9.5
	Do Minimum	5.4	5.7	7.2	9.5
	Do Nothing	5.4	6.7	8.2	12.0
	Custom	5.4	3.9	3.9	3.0

Evaluation of All Fundamental Road Network (26,000 km)

Fundamental Network Required Expenditures Without Budget Constraints (Optimal Scenario)

The table below presents the required expenditures without budget constraints over the next five years and in years 6 to 20, in US$ million, for the fundamental network of 26,000km.

Optimal Scenario

Years 1-5

Road Agency Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	2,267.0	0.0	2,267.0	69%
F. Unpaved	0.0	1,025.0	1,025.0	31%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	2,267.0	1,025.0	3,292.0	100%
Percent	69%	31%	100%	

Rehabilitation Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	1,185.8	0.0	1,185.8	61%
F. Unpaved	0.0	744.0	744.0	39%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	1,185.8	744.0	1,929.8	100%
Percent	61%	39%	100%	

Periodic Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	933.7	0.0	933.7	85%
F. Unpaved	0.0	168.6	168.6	15%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	933.7	168.6	1,102.3	100%
Percent	85%	15%	100%	

Recurrent Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	147.5	0.0	147.5	57%
F. Unpaved	0.0	112.4	112.4	43%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	147.5	112.4	259.9	100%
Percent	57%	43%	100%	

Years 6-20

Road Agency Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	2,373.8	0.0	2,373.8	57%
F. Unpaved	0.0	1,786.4	1,786.4	43%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	2,373.8	1,786.4	4,160.2	100%
Percent	57%	43%	100%	

Rehabilitation Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	487.3	0.0	487.3	100%
F. Unpaved	0.0	0.0	0.0	0%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	487.3	0.0	487.3	100%
Percent	100%	0%	100%	

Periodic Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	1,479.7	0.0	1,479.7	51%
F. Unpaved	0.0	1,449.3	1,449.3	49%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	1,479.7	1,449.3	2,928.9	100%
Percent	51%	49%	100%	

Recurrent Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	406.9	0.0	406.9	55%
F. Unpaved	0.0	337.1	337.1	45%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	406.9	337.1	744.0	100%
Percent	55%	45%	100%	

The table below presents the required expenditures without budget constraints over the next five years and in years 6 to 20, in US$ million per year. Over the next five years, US$ 658 million per years is needed for rehabilitation, periodic maintenance and routine maintenance of the total network, of which 69% should go to the paved roads.

Optimal Scenario

Years 1-5

Road Agency Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	453.4	0.0	453.4	69%
F. Unpaved	0.0	205.0	205.0	31%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	453.4	205.0	658.4	100%
Percent	69%	31%	100%	

Rehabilitation Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	237.2	0.0	237.2	61%
F. Unpaved	0.0	148.8	148.8	39%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	237.2	148.8	386.0	100%
Percent	61%	39%	100%	

Periodic Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	186.7	0.0	186.7	85%
F. Unpaved	0.0	33.7	33.7	15%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	186.7	33.7	220.5	100%
Percent	85%	15%	100%	

Recurrent Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	29.5	0.0	29.5	57%
F. Unpaved	0.0	22.5	22.5	43%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	29.5	22.5	52.0	100%
Percent	57%	43%	100%	

Years 6-20

Road Agency Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	158.3	0.0	158.3	57%
F. Unpaved	0.0	119.1	119.1	43%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	158.3	119.1	277.3	100%
Percent	57%	43%	100%	

Rehabilitation Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	32.5	0.0	32.5	100%
F. Unpaved	0.0	0.0	0.0	0%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	32.5	0.0	32.5	100%
Percent	100%	0%	100%	

Periodic Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	98.6	0.0	98.6	51%
F. Unpaved	0.0	96.6	96.6	49%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	98.6	96.6	195.3	100%
Percent	51%	49%	100%	

Recurrent Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	27.1	0.0	27.1	55%
F. Unpaved	0.0	22.5	22.5	45%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	27.1	22.5	49.6	100%
Percent	55%	45%	100%	

Fundamental Network Comparison of Budget Scenarios

The table below presents the rehabilitation, periodic maintenance and routine maintenance needs over the next five years, in US$ million per year, of the different budget scenarios evaluated. Scenarios Optimal +1 and Optimal +2 require more expenditures than the optimal scenario, which maximizes the network NPV. The other scenarios represent different levels of budget constraints.

Annual Road Agency Costs Years 1-5 (Annual Costs Years 1-5)

		Annual Costs Years 1-5, M$/year			
Network	Scenario	Rehabilitation	Periodic Maint.	Recurrent Maint.	Road Agency
Total Network	Optimal +2	520.0	265.6	78.6	864.2
	Optimal +1	461.3	270.8	73.0	805.1
	Optimal	386.0	220.5	52.0	658.4
	Optimal -1	369.9	48.0	53.2	471.1
	Optimal -2	250.0	82.8	50.5	383.3
	Optimal -3	206.6	71.7	25.8	304.1
	Do Minimum	127.5	0.0	21.1	148.6
	Do Nothing	0.0	0.0	0.0	0.0
	Custom	461.7	327.3	89.0	878.0

The table below show the comparison of the budget scenarios in terms of present value of agency costs at 6% discount rate.

Present Value of Society Costs

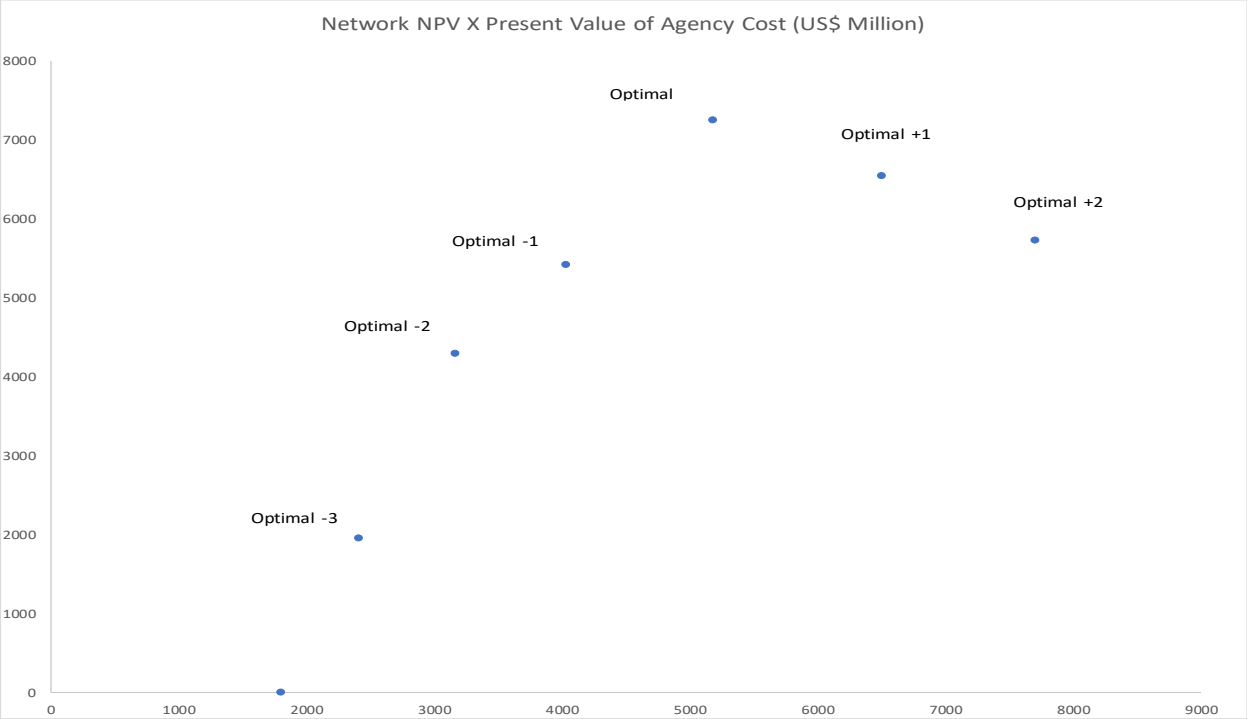
		Present Value Years 1 to 20 at 6 percent (M$)		
Network	Scenario	Road Agency	Road Users	Society
Total Network	Optimal +2	7,707	44,270	51,977
	Optimal +1	6,506	44,655	51,161
	Optimal	5,178	45,272	50,450
	Optimal -1	4,033	48,255	52,288
	Optimal -2	3,164	50,245	53,409
	Optimal -3	2,408	53,345	55,753
	Do Minimum	1,798	55,904	57,702
	Do Nothing	0	59,295	59,295
	Custom	7,340	45,694	53,034

The table below show the resulting NPV of the different budget scenarios

Present Value Society Net Benefits Compared to Do Minimum Standard (NPV)

Network	Scenario	Society Costs (M$)	Net Benefit (M$)	Net Benefit (M$/year)
Total Network	Optimal +2	51,977	5,725	286.3
	Optimal +1	51,161	6,541	327.1
	Optimal	50,450	7,252	362.6
	Optimal -1	52,288	5,415	270.7
	Optimal -2	53,409	4,293	214.7
	Optimal -3	55,753	1,949	97.5
	Do Minimum	57,702	0	0.0
	Do Nothing	59,295	-1,593	-79.7
	Custom	53,034	4,668	233.4

A chart of the network NPV compared to the present value of agency costs of the different budget scenarios is given below.



The table below show the average roughness of the network under the different budget scenario. The optimal scenario will decrease the average roughness from the current 9.7 IRI to 5.0 IRI in ten years. The Optimal -2 scenario will keep the network at around the same condition as today.

Roughness Weighted by Km

Network	Scenario	Roughness by Km (IRI, mm/km)			
		Current	Year 5	Year 10	Year 20
Total Network	Optimal +2	9.7	4.7	5.0	4.1
	Optimal +1	9.7	5.2	5.3	5.7
	Optimal	9.7	5.7	6.0	6.8
	Optimal -1	9.7	7.0	7.7	8.4
	Optimal -2	9.7	8.9	9.4	10.9
	Optimal -3	9.7	11.0	11.8	13.0
	Do Minimum	9.7	13.5	14.2	15.4
	Do Nothing	9.7	15.4	16.2	18.2
	Custom	9.7	7.4	7.4	6.9

Fundamental Network Required Expenditures to Keep Current Road Condition (Optimal -2 Scenario)

The table below presents the required expenditures, to keep the current network condition (Optimal -2 scenario), over the next five years and in years 6 to 20, in US$ million, for the fundamental network of 26,000km.

Optimal -2 Scenario

Years 1-5

Road Agency Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	942.7	0.0	942.7	49%
F. Unpaved	0.0	973.8	973.8	51%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	942.7	973.8	1,916.5	100%
Percent	49%	51%	100%	

Rehabilitation Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	754.0	0.0	754.0	60%
F. Unpaved	0.0	496.0	496.0	40%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	754.0	496.0	1,250.0	100%
Percent	60%	40%	100%	

Periodic Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	97.9	0.0	97.9	24%
F. Unpaved	0.0	316.2	316.2	76%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	97.9	316.2	414.1	100%
Percent	24%	76%	100%	

Recurrent Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	90.8	0.0	90.8	36%
F. Unpaved	0.0	161.6	161.6	64%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	90.8	161.6	252.3	100%
Percent	36%	64%	100%	

Years 6-20

Road Agency Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	1,313.8	0.0	1,313.8	46%
F. Unpaved	0.0	1,538.8	1,538.8	54%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	1,313.8	1,538.8	2,852.6	100%
Percent	46%	54%	100%	

Rehabilitation Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	919.0	0.0	919.0	100%
F. Unpaved	0.0	0.0	0.0	0%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	919.0	0.0	919.0	100%
Percent	100%	0%	100%	

Periodic Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	168.6	0.0	168.6	14%
F. Unpaved	0.0	1,054.0	1,054.0	86%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	168.6	1,054.0	1,222.6	100%
Percent	14%	86%	100%	

Recurrent Maintenance Costs (M$)

Network	Paved	Unpaved	Total	Percent
F. Paved	226.2	0.0	226.2	32%
F. Unpaved	0.0	484.8	484.8	68%
Complement	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	226.2	484.8	710.9	100%
Percent	32%	68%	100%	

Optimal -2 Scenario

Years 1-5

Road Agency Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	188.5	0.0	188.5	49%
F. Unpaved	0.0	194.8	194.8	51%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	188.5	194.8	383.3	100%
Percent	49%	51%	100%	

Rehabilitation Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	150.8	0.0	150.8	60%
F. Unpaved	0.0	99.2	99.2	40%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	150.8	99.2	250.0	100%
Percent	60%	40%	100%	

Periodic Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	19.6	0.0	19.6	24%
F. Unpaved	0.0	63.2	63.2	76%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	19.6	63.2	82.8	100%
Percent	24%	76%	100%	

Recurrent Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	18.2	0.0	18.2	36%
F. Unpaved	0.0	32.3	32.3	64%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	18.2	32.3	50.5	100%
Percent	36%	64%	100%	

Years 6-20

Road Agency Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	87.6	0.0	87.6	46%
F. Unpaved	0.0	102.6	102.6	54%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	87.6	102.6	190.2	100%
Percent	46%	54%	100%	

Rehabilitation Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	61.3	0.0	61.3	100%
F. Unpaved	0.0	0.0	0.0	0%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	61.3	0.0	61.3	100%
Percent	100%	0%	100%	

Periodic Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	11.2	0.0	11.2	14%
F. Unpaved	0.0	70.3	70.3	86%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	11.2	70.3	81.5	100%
Percent	14%	86%	100%	

Recurrent Maintenance Costs (M$/year)

Network	Paved	Unpaved	Total	Percent
F. Paved	15.1	0.0	15.1	32%
F. Unpaved	0.0	32.3	32.3	68%
Complementa	0.0	0.0	0.0	0%
Urban	0.0	0.0	0.0	0%
Unclassified	0.0	0.0	0.0	0%
Total	15.1	32.3	47.4	100%
Percent	32%	68%	100%	