

Performance Based Routine Maintenance Contracting for Low Volume Sealed Roads

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Abstract

Performance-based contracts are substitute to the conventional contracts used in the procurement of road maintenance, whereby the main emphasis is not only on contract management and maintenance, but also on all happenings associated with the management and evaluation of the road section under contract. The performance-based contractor is wholly accountable for the works required to achieve the obligatory service levels, durability and performance of the road over the contract period. The Roads 2000 Strategy (R2000) was conceptualized and implemented in central Kenya. The completed projects were required to be subjected to timely and continuous maintenance. In addition, the projects under phase two of the program incorporated three-year performance contracts for maintenance, that were to kickstart upon the completion of the construction phases. This study was aimed at evaluating the level and extent of maintenance planning and implementation on improved projects, and also the effectiveness of the embedded performance-based maintenance contracts in ensuring that prioritisation for maintenance was enhanced, and that acceptable service levels were maintained during the period the contracts were in effect, and drawing the lessons learnt. An overall assessment of the investment in maintenance of completed projects under the Roads 2000 program was carried out, from the time the initial projects were handed over for maintenance, up until when the phase two projects were completed and handed over. Correlation was drawn between the previous efforts in maintenance prior to introduction of performance-based maintenance contracting, and thereafter. It was observed that performance-based contracts had an overall effect of increasing the road lengths that were maintained, and also led to an increase on the level of prioritisation for maintenance. There was an observed increase on the budgetary allocation per unit length of road per year with the introduction of performance based routine maintenance. However, monitoring of set service levels was observed to be still an area that needed to be improved during the management of performance-based contracts.

Keywords: Performance-based routine maintenance, roads 2000, low volume, maintenance, fuel levy, financial year (fy), annual public roads programme

INTRODUCTION

The transportation sector is one of Kenya's major pillars of economic development contributing 10.7 per cent to the Gross Domestic Product (GDP) in the year 2022 (KRB, 2023). The performance of the transport sector improved in 2022, and road transport was the most predominant mode of transport in Kenya, accounting for over 90 per cent of all freight and passenger traffic (KNBS, 2023). Kenya's road assets are valued at over Kshs 3.5 trillion and therefore there is need to establish the road asset administration in the its development strategy, to facilitate road maintenance, rehabilitation and development in an effective manner (KRB, 2023).

Road maintenance serves the purpose of preserving the road asset, and needs to be done regularly and timely to be effective. Road maintenance is classified as either emergency, routine or periodic. Routine maintenance includes limited works carried out frequently, aimed at ensuring that the usability and safety of the road in the short-run is guaranteed, and to avert early decline of the road condition (PIARC 1994). Frequency of activities varies but is generally once or more than a week or month. Characteristic activities usually comprise of bush clearance, desilting of culverts and drains, pothole patching and repair, and grading and gravelling of gravel roads (Sally et al, 2005).

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Periodic maintenance is aimed at preserving the structural integrity of a road section, and the encompassed activities are large scale, thereby needful of specific equipment and skilled workers. This type is costly, as compared to routine maintenance. The activities require precise identification and planning for design and execution, and they are classified as either preventive, resurfacing, overlay or pavement reconstruction. Emergency works are carried out for maintenance that is unforeseen, and necessitates urgent action (Sally et al, 2005).

Maintenance of roads is carried by either using labour or machinery, dependent on the type, severity, and extent of road distresses. Equipment is preferred on heavy and extensive maintenance procedures, whereas labour is used on small scale works that incorporate simple hand tools and light machinery (Berhane, 2023). When roads are constructed and opened to traffic, they incur functional and structural decline necessitating maintenance, as a result of excessive traffic loading and environmental effects (Yonghong et al, 2019). With an expanding network and limited available funds, appropriate maintenance is vital to keep good serviceability of the roads and curtail costs of operation (Simoes et al, 2017).

Performance Based Routine Maintenance

Traditional road construction contracts have been in use for many decades despite a significant drawback: they are founded on the quantity of work implemented, which can create the wrong incentive for some contractors to maximize profits by inflating the volume of work. Additionally, construction contracts don't take long-term maintenance into account, which can result in substandard road conditions and a lack of accountability. This approach can lead to inefficiencies, higher costs, and a misalignment of incentives between governments and contractors. The end result is that the road users will end up with high operating costs (The World Bank, 2022).

The development of Performance Based Contracts (PBCs) started some ten years before the turn of the 21st century. This type of contracting was introduced in North America, and used to contract out maintenance of roads to the private sector by setting some performance levels to be attained in the course of routine maintenance. Consequently, some countries in South America

began to contract out most of their trunk roads by use of performance levels for maintenance works, with a consequence charge for not meeting the set times for remedying road failures. Over the years thereafter, PBCs have been adopted worldwide, as they were found to deliver better value for money than traditional contracts, as well as ensuring better road conditions (ADB, 2018).

In their study, Prasad et al studied the use of PBCs for maintenance. PBCs were compared to conventional contract types, and the study also evaluated their effect on cost savings, benefits on users, quality of maintenance achieved, covering Zambia, Brazil, Argentina, Sri Lanka, and Indonesia. The study observed that PBCs achieved scored in the improvement of road quality and increased the occurrence of maintenance operations. PBCs also led to lower costs when compared with conventional contracts (Prasad et al, 2022).

At procurement of PBCs, the service providers compete amongst one another, by offering fixed costs per unit length per month for rehabilitating the road to the needed service levels, and then sustaining them for a stated timeline. During implementation, the contractor's payments are based on measured productivities commensurate to the stated target conditions of the contracted. In addition, a monthly lumpsum payment is made to the contractor to cater for all physical and non-physical maintenance activities undertaken, save for unanticipated emergency works. The client is additionally able to add to the scope of the contractor essential rehabilitation activities to bring the road up to the pre-stated condition, and for such works, the contractor is compensated at unit charges using standard bills of quantities (JICA, 2016).

Service levels go together with response times and the allowable tolerance. Service levels are set appropriately by consideration of road function, capacity of the contractor, volume of traffic, climate and type of road surface. The service levels should neither be set too low nor too high. The purpose of level setting is: (i) to provide a typical method of setting the scope, response times and acceptable tolerances of the service level, and (ii) to settle on different sets of service levels dependent on the road type and the volume of traffic on the road (JICA, 2016).

PBCs provide better ride quality to the road users in comparison with the conventional contracts. The contracts hold a likely economic advantage owing to reduced maintenance cost in the long run. Moreover, in consideration of the social and economic losses due to ill maintained roads, PBC offer substantial benefits. In addition, PBCs permit the service providers to exploit innovation since the concept shifts the procedure and regularity of maintenance activities from the project owner to the contractor (JICA, 2016).

Zietlow, in 2017, highlighted the learnt lessons in the execution of the PBCs in several jurisdictions and observed that by shifting from conservative maintenance contracts, based on similar levels of service, between 20% and 30% savings had been attained. The study also noted that better competition among competent and innovative contractors, long-term contracts, and harmonising of risks between the project owner and contractor were the leading factors for cost savings (Zietlow, 2017).

Gelderman et al, in 2019, investigated PBCs in Netherlands, finding issues that lead to poor contractor performance. The study observed that contracting out road maintenance created many challenges and multiple risks induced by PBCs. It was suggested that a good awareness of the diverse risks would improve the ability to successfully manage maintenance PBCs. Specifications related to the road are normally not well expounded into technical provisions by the contractor, in line with the intent of the project owner. The efficiency of the incentive compensation method is another serious subject in using PBCs (Gelderman et al, 2019). During the formulation of incentive plans, the project owners need to put into consideration inadvertent effects as well as desired performance (McDonald et al, 2009).

Mostafa, in 2018, investigated the road maintenance in Africa, its tactics and outlooks. The study observed that the road maintenance's effort in most African countries was significant, but these efforts were meagre in comparison to those of other developing nations in the world. The study recommended integration of maintenance into infrastructure and sector policies, consideration of establishing of road fund concept, incorporation of PBCs for maintenance works, and participation of public-private partnership business concept

(Mostafa, 2018).

Mulmi, in 2016, undertook an assessment of performance-based road maintenance practices in Nepal. The study observed that most of the maintenance work was founded on the conservative quantity and unit price based short term maintenance contracts, where maintenance of physical works was outsourced. Here, the project owner prescribed to the contractor which activities were to be carried out, the timeline and the scope of the work. The study reported that a trial had been undertaken, based on PBCs, in 2003. Comparison of the maintenance cost based on the conventional practice and PBCs was carried out, and the cost comparison showed that PBCs led to more cost savings (Mulmi, 2016).

Problem Studied

The Agence Française de Développement (AfD)/ Government of Kenya (GoK) funded Roads 2000 Program, phase one component, was implemented in Nyandarua and Murang'a regions of Central Kenya from 2007 to 2011 with an overall budget of 22 mill Euro, out of which AfD provided 20 mill and GoK Provided 2 mill Euro. The project met most of its objectives including training of contractors and supervisors, rehabilitation of 1,000 km of gravel roads and construction of a 6.7 Km low volume seal demonstration road.

In 2010 the AfD provided a facility of €40 million to assist the GoK in developing its rural road network, to increase employment opportunities and wealth creation, and help reduce poverty in the central area of the country through the Roads 2000 Central phase two project covering Kiambu, Murang'a, Kirinyaga, Nyeri, Nyandarua and Laikipia regions. The phase two program in central region of Kenya effectively started in March 2011, with the original completion date of February 2015, which was later revised to December 2019. The low volume roads implemented under the phase two of the program were 157.3Km, which consisted of 4 Km demo road, 17.6 Km batch one contracts, 50.4 Km of batch two contracts and 76.4Km of batch three.

As part of the agreement for funding of the roads program, the completed roads needed to be handed over to maintenance thereupon, and there needed to be a continuous and adequate maintenance program in place. The

line authorities who received the completed roads included the Kenya Rural Roads Authority (KeRRA) and County Governments, who obtain the maintenance funding, collected from fuel levy, by the Kenya Roads Board (KRB), a body mandated to manage roads maintenance. Assessment was carried out, with a keen emphasis on the budgetary allocation for maintenance by these authorities, and the lengths of road maintained, on the regions where the Roads 2000 program-improved roads are domiciled.

In addition, under phase two projects, each contract of the low volume sealed roads was designed to include a 36-month Performance Based Routine Maintenance (PBRM). The PBRM was done as a trial and to set pace to the road authorities receiving the roads eventually, in regards to the maintenance service levels required on the completed roads. Evaluation was done to deduce the impact of the performance-based maintenance contracts on the overall priority for maintenance, and the budget allocation and road lengths maintained.

RESEARCH METHODS

The completed road network, already handed over to the authorities comprising of KeRRA and County Governments, were assessed. The authorities receive Road Maintenance Levy Fund (RMLF) from the Kenya Roads Board, informed by the priority work plans by the authorities, consolidated on the Annual Public Roads Programme (APRP).

The rationale of the selected roads was APRP allocations, in addition to the budgeted contract sums for the PBRM embedded contracts. The APRPs are a product of prioritisation arrived at after consultation with the stakeholders. The sampled roads in the network encompassed the completed roads under the Roads 2000 program, being maintained under the 22% KRB allocation to KeRRA and the 15% allocation to the respective County Governments.

The APRPs for seven years, i.e., financial years 2011/2012 to 2017/2018, were examined to obtain data to ascertain the level of investment put in place on the road network in Central Kenya, consisting of improved roads, for the maintenance regimes. In addition, the embedded PBRM contracts under

phase two of the program were analysed in terms of their impact on the level of prioritisation for maintenance by the said authorities.

The research was particularly interested on the funding allocation per unit length of road, and how this amount was changing over the period following the introduction of PBC contracting. For comparison of the enormous data, excel datasheets were utilised for the data analysis. The data was presented as tables and charts for ease of correlation.

RESULTS

Network Routine Maintenance

The program defined the targets for routine maintenance of the KeRRA's network in the six regions of central Kenya as shown in **Table 1**.

It was observed that the planned and actual lengths maintained had reduced from FY 2011/12 to FY 2017/18, as also shown in **Table 2** and **Figure 1**. It was to be noted that shortage of funds and utilisation of the available funds to undertake spot improvement works and/or open new roads were among the reasons for the decrease in road lengths maintained annually.

For the FY 13/14, the planned Routine Maintenance was 4,829 km, which included most of the roads improved under the phase one project and the 145 km improved under the phase two project. The RMLF budget allocation was Kshs 770 Mill excluding the amounts from coffee cess and GOK special allocations.

A total of Kshs 1.045 Bill was received which included Kshs 15.7 Mill and 7.2 Mill per Constituency under 22% and 10% RMLF respectively. Kshs 929.1 Mill was utilised to maintain 4,472 Km or 93% of the planned works as shown in **Table 3**.

For FY 14/15, the targeted length to be maintained reduced considerably to 4,026Km with an RMLF budget allocation of Kshs 613 Mill. Each constituency received Kshs 13.9 Mill under 22% and Kshs 6.3 Mill under 10% allocations. In total Kshs 890 Mill was utilised to maintain 3,848 Km or 96% of the planned total road network in the six regions. This amount included coffee cess and special allocation as shown in **Table 4**

TABLE 1
 Routine maintenance network targets

| Project Year/ Financial Year | Project Targets (Km) | |
|------------------------------|-------------------------|--------------------------|
| | Maintainable Roads (Km) | Improved by Project (Km) |
| Year 1 - 2011/12 | 5,057 | - |
| Year 2 - 2012/13 | 5,057 | 100 |
| Year 3 - 2013/14 | 5,157 | 100 |
| Year 4 - 2014/15 | 5,257 | 330 |
| Year 5 - 2015/16 | 5,587 | 95 |
| Year 6 - 2016/17 | 5,682 | 240 |
| Year 7 - 2017/18 | 5,922 | - |
| TOTAL | 37,719 | 865 |

Source: Author, 2024

TABLE 2
 Summary of total utilised Government of Kenya (GOK) Funds Financial Years (FY) 2011-12 to 2017-18 in the Central Kenya Project Region

| Financial Year | Subtotal RMLF Disbursed (Kshs) | GOK/Special Allocation (Kshs) | Coffee Cess (Kshs) | Total Budget (Kshs) | Road Length Planned (Km) | Road Length Done (Km) / Percentage | |
|----------------------|--------------------------------|-------------------------------|--------------------|----------------------|--------------------------|------------------------------------|------------|
| Year 1 FY 11/12 | 860,630,757 | 188,754,651 | 96,793,954 | 1,146,179,362 | 6,022 | 5,044 | 84% |
| Year 2 FY 12/13 | 753,306,259 | 259,340,089 | 99,124,595 | 1,111,770,942 | 5,263 | 4,802 | 91% |
| Year 3 FY 13/14 | 751,870,085 | 74,969,683 | 82,420,611 | 909,260,379 | 4,829 | 4,472 | 93% |
| Year 4 FY 14/15 | 613,797,807 | 197,256,332 | 79,024,169 | 890,078,307 | 4,026 | 3,848 | 96% |
| Year 5 FY 15/16 | 641,521,012 | 127,706,712 | 21,174,384 | 790,402,108 | 4,330 | 3,580 | 83% |
| Year 6 FY 16/17 | 858,724,175 | 158,437,706 | - | 1,017,161,881 | 3,219 | 2,523 | 83% |
| Year 7 FY 17/18 | 618,905,561 | 133,653,239 | - | 752,558,801 | 2,740 | 2,269 | 81% |
| Total/Average | 5,098,755,656 | 1,140,118,412 | 378,537,712 | 6,617,411,781 | 4,347 | 3,791 | 87% |

Source: Author, 2024

For FY 15/16, the six regions had planned to maintain 4,330 Km with a budget of Kshs 774 Mill excluding the amounts from coffee cess and GOK special allocations. The budget ceilings for RMLF were Kshs 18 Mill per constituency under 22% and 8 Mill per constituency under 10% allocations, which was an increase from the previous year. A total Kshs. 923 Mill was utilised to maintain 3,580 Km or 83% of the planned total road network in the six regions as shown in **Table 5**.

For FY 16/17, the six regions had planned to maintain 3,219 Km with a budget of Kshs 800 Mill excluding the amounts from Coffee cess and GOK special allocations. The RMLF disbursed Kshs 20.2 Mill per constituency under 22% allocation,

and Kshs 9.2 Mill per constituency under 10% allocation. A total Kshs. 992 Mill was utilised to maintain 2,523 Km or 78% of the planned total road network in the six regions as shown in **Table 6**.

For FY 17/18, the six regions had planned to maintain 2,740 Km with a budget of Kshs 617 Mill excluding the GOK special allocations. The RMLF disbursed Kshs 20.2 Mill per constituency under 22% allocation, and Kshs 9.2 Mill per constituency under 10% allocation. A total of 2,269 Km was maintained using Kshs 751 Mill, as shown **Table 7**.

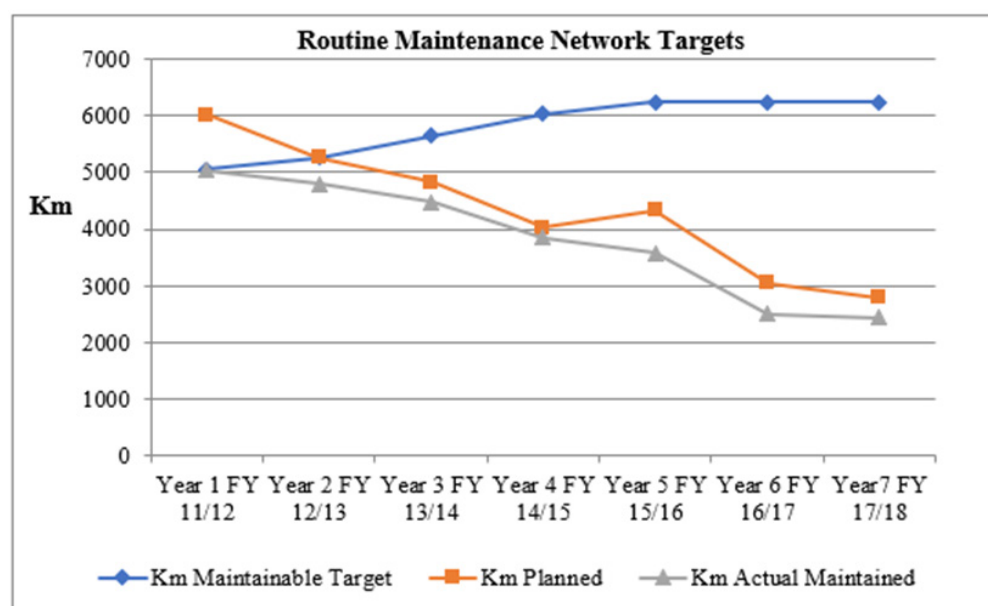


FIGURE 1
 Showing the comparison between project maintainable roads target versus actual maintained
 Source: Author, 2024

TABLE 3
 FY 13-14 RMLF -Utilised GOK Funds

| Regions | Total RMLF (Kshs) | GOK/Special Allocation (Kshs) | Coffee Cess (Kshs) | Total Cost Utilised (Kshs) | Total Length Planned (Km) | Road Length Done (Km) / Percentage | |
|--------------|--------------------|-------------------------------|--------------------|----------------------------|---------------------------|------------------------------------|------------|
| Kiambu | 257,413,570 | - | 29,432,088 | 286,845,658 | 611 | 567 | 93% |
| Kirinyaga | 75,542,351 | 29,140,151 | 15,514,125 | 120,196,626 | 697 | 679 | 97% |
| Laikipia | 65,594,144 | - | - | 65,594,144 | 561 | 508 | 91% |
| Murang'a | 126,482,072 | 11,765,701 | 21,128,762 | 159,376,535 | 1,181 | 1,156 | 98% |
| Nyandarua | 118,272,406 | - | - | 118,272,406 | 1,136 | 852 | 75% |
| Nyeri | 128,459,224 | 34,063,831 | 16,345,637 | 178,868,691 | 642 | 709 | 110% |
| Total | 771,763,767 | 74,969,683 | 82,420,611 | 929,154,061 | 4,829 | 4,472 | 93% |

Source: Author, 2024

Overall Maintenance of Project Improved Roads

While the target of 100% maintenance of improved roads was never achieved during the phase one project, the number of improved roads under maintenance increased from 64% in FY 08/09 to 88% in FY 10/11 with a corresponding increase in funding from 66,000 Kshs/Km to 89,000 Kshs/Km per year. After the closure of the phase one project i.e., for the FY 11/12, the maintenance of project improved roads was reduced by 106 km and Kshs 13 Mill in budget, and only 59% of the improved roads were maintained.

decreased from 1,016 Km to 945 Km. The reduction of 71 km consisted of roads that had either been planned for upgrading or were under contract for upgrading, either through low volume sealing or traditional upgrading contracts. Out of the available 945 Km, 742.5 Km or 79% was programmed for maintenance. The amount of funds for maintenance increased from Kshs 53.5 mill to Kshs 87.4 mill, which was a marked improvement. A total of 679 Km of road sections received some maintenance at a cost of 86.5 mill Kshs as shown in **Table 8**.

For the FY 12/13 work plan, the length of project improved roads available for maintenance

During the FY 13/14 the improved roads under the Phase 1 and Phase 2 project, approximately

TABLE 4
FY 14-15 RMLF - Utilised GOK Funds

| Regions | Consti- tu-en- cies | Total RMLF (Kshs) | GOK/Spe- cial Alloca- tion (Kshs) | Coffee Cess (Kshs) | Total Cost Utilised (Kshs) | Total Length Planned (Km) | Road Length Done (Km) / Percentage | |
|----------------|---------------------------|----------------------|---|-----------------------|----------------------------------|------------------------------------|--|------------|
| Kiambu | 12 | 214,649,490 | - | 32,230,797 | 246,880,287 | 554 | 520 | 94% |
| Kirinyaga | 4 | 72,213,705 | 79,871,958 | 20,464,604 | 172,550,267 | 691 | 605 | 88% |
| Laikipia | 3 | 54,334,092 | - | - | 54,334,092 | 381 | 392 | 103% |
| Murang'a | 7 | 94,548,415 | - | 17,105,830 | 111,654,245 | 774 | 689 | 89% |
| Nyan- darua | 5 | 71,083,162 | 12,237,061 | - | 83,320,223 | 773 | 858 | 111% |
| Nyeri | 6 | 106,968,943 | 105,147,313 | 9,222,938 | 221,339,194 | 854 | 784 | 92% |
| Total | 37 | 613,797,807 | 197,256,332 | 79,024,169 | 890,078,307 | 4,026 | 3848 | 96% |

Source: Author, 2024

TABLE 5
FY 15-16 RMLF - Utilised GOK Funds

| Regions | Consti- tu-en- cies | Total RMLF (Kshs) | GOK/Spe- cial Alloca- tion (Kshs) | Coffee Cess (Kshs) | Total Cost Utilised (Kshs) | Total Length Planned (Km) | Road Length Done (Km) / Percentage | |
|----------------|---------------------------|----------------------|---|-----------------------|----------------------------------|------------------------------------|--|------------|
| Kiambu | 12 | 225,790,505 | - | - | 225,790,505 | 626.2 | 617.0 | 99% |
| Kirinyaga | 4 | 95,909,338 | 81,588,358 | 21,174,384 | 198,672,080 | 611.2 | 814.3 | 133% |
| Laikipia | 3 | 57,895,882 | - | - | 57,895,882 | 646.1 | 226.6 | 35% |
| Murang'a | 7 | 184,152,041 | 12,599,820 | - | 196,751,861 | 975.3 | 839.4 | 86% |
| Nyan- darua | 5 | 77,773,247 | 33,518,534 | - | 111,291,781 | 737.0 | 533.3 | 72% |
| Nyeri | 6 | 132,911,250 | - | - | 132,911,250 | 734.6 | 549.7 | 75% |
| Total | 37 | 774,432,262 | 127,706,712 | 21,174,384 | 923,313,358 | 4330.4 | 3580.3 | 83% |

Source: Author, 2024

TABLE 6
FY 16-17 RMLF - Utilised GOK Funds

| Regions | Consti- tu-enc- ies (No) | Total RMLF (Kshs) | GOK/Special Allocation (Kshs) | Total Cost Utilised (Kshs) | Total Length Planned (Km) | Road Length Done (Km) / Percentage | |
|----------------|-----------------------------------|----------------------|-------------------------------------|----------------------------------|------------------------------------|---------------------------------------|------------|
| Kiambu | 12 | 223,163,558 | - | 223,163,558 | 499 | 455 | 91% |
| Kirinyaga | 4 | 80,542,417 | 158,437,706 | 238,980,124 | 429 | 429 | 100% |
| Laikipia | 3 | 49,184,974 | - | 49,184,974 | 139 | 99 | 72% |
| Murang'a | 7 | 292,123,704 | - | 292,123,704 | 689 | 613 | 89% |
| Nyan- darua | 5 | 44,502,803 | - | 44,502,803 | 890 | 392 | 44% |
| Nyeri | 6 | 110,696,494 | - | 145,039,362 | 572 | 535 | 93% |
| Total | 37 | 800,213,950 | 158,437,706 | 992,994,524 | 3,219 | 2,523 | 78% |

Source: Author, 2024

TABLE 7
 FY 17-18 RMLF -Utilised GOK Funds

| Regions | Consti- tu- encies (No) | Total RMLF (Kshs) | GOK/Special Allocation (Kshs) | Total Cost Utilised (Kshs) | Total Length Planned (Km) | Road Length Done (Km) / Percentage | |
|----------------|----------------------------------|----------------------|-------------------------------------|----------------------------------|------------------------------------|---------------------------------------|------------|
| Kiambu | 12 | 40,698,281 | - | 40,698,281 | 389.3 | 82 | 21% |
| Kirinyaga | 4 | 93,429,608 | 133,653,239 | 227,082,847 | 294.9 | 335 | 114% |
| Laikipia | 3 | 51,435,750 | - | 51,435,750 | 212.0 | 89 | 42% |
| Murang'a | 7 | 183,527,825 | - | 183,527,825 | 455.3 | 455 | 100% |
| Nyan- darua | 5 | 115,438,347 | - | 115,438,347 | 874.2 | 832 | 95% |
| Nyeri | 6 | 132,791,318 | - | 132,791,318 | 513.9 | 476 | 93% |
| Total | 37 | 617,321,128 | 133,653,239 | 750,974,368 | 2,739.6 | 2,269 | 83% |

Source: Author, 2024

1,103 Km were available for maintenance. Out of these, a total of 884 km had been planned for maintenance, including 40 PBRM contracts covering 370 Km. Unfortunately, this still left 219 Km which had not been planned for maintenance. 733Km were maintained leaving a balance of 370 km not being maintained as shown in **Table 8**.

For the FY 14/15, an additional 115 Km was completed by end of December 2014, and were expected to be maintained by the authorities in the regions from March 2015 after the expiry of defects liability period. This raised the length of roads improved by the project and available for maintenance to about 1,218Km, out of which 961 Km was planned for maintenance. As at December 2015, 661Km had been maintained leaving a balance of 557 km not being maintained as shown in **Table 8**.

For FY 15/16, an additional 250 Km were completed and handed over for maintenance. This raised the length of road improved by the project and available for maintenance to 1,468 Km. The work plans showed that only 897 Km or 61% of the improved roads were planned for maintenance. Out of the 897 km planned, 595 Km were maintained which was 41% of the improved road length, as shown in **Table 8**.

For FY 16/17, an additional 77 Km were completed and handed over for maintenance. This raised the length of road improved by the project and available for maintenance to 1,545 Km. This length included 38.3 Km of road sections improved under

batch two low volume seal, which had inbuilt three years' performance-based maintenance contracts. The work plans showed that only 1,018 Km or 66% of the improved roads were planned for maintenance and 591 Km were maintained leaving a balance of 527 km not being maintained as shown in **Table 8**.

As is shown in **Table 8** and **Figure 2**, the six regions were planning to maintain less than half of the total road length improved.

Performance Based Maintenance of Project improved roads

During the financial year (FY) 13/14, Murang'a and Nyandarua Regions planned to maintain a total of 733 Km out of the available 945 Km of Phase 1 roads, or 77% on average. In both regions, a total of 18 PBRM contracts were used to maintain the Phase 1 Batch 3 roads which were the same roads maintained by use of PBRM contracts during the previous two financial years. In addition, all the Phase 2 Batch 1 improved roads in Kiambu, Kirinyaga, Nyeri, Murang'a and Laikipia regions were maintained using 22 PBRM contracts during the FY 13/14. Nyeri Region maintained an additional 12 Km which were improved through demonstration roads using training funds. 733 Km or 83% of the targeted length were maintained in all the regions using Kshs 124.3 Mill.

For FY 2014/15, 961 Km or 79% of the project roads were planned for routine maintenance in the six regions of Murang'a, Nyandarua, Kiambu, Kirinyaga, Nyeri, and Laikipia. It was noted

TABLE 8
 Maintenance of Phase 1 and Phase 2 Project Roads

| Project Year | Length of Project Roads for Maintenance (Km) | PBRM Maintenance Contracts (No.) | Road Length Planned for Maintenance (Km) | Road Length Maintained (Km) | Road Length Not Maintained (Km) | Percentage Maintained | Cost (Mill Kshs) | Cost per Road Length (Kshs / KM) |
|--------------------|--|----------------------------------|--|-----------------------------|---------------------------------|-----------------------|------------------|----------------------------------|
| Year 2 - FY 08/09 | 200 | - | 145 | 127 | 73 | 64% | 7.1 | 55,984 |
| Year 3 - FY 09/10 | 696 | - | 600 | 557 | 139 | 80% | 36.3 | 65,189 |
| Year 4 - FY 10/11 | 857 | 20 | 800 | 757 | 100 | 88% | 67.2 | 88,719 |
| Year 5 - FY 11/12 | 1016 | - | 750 | 601 | 415 | 59% | 53.5 | 88,952 |
| Year 6 - FY 12/13 | 945 | 27 | 743 | 679 | 266 | 72% | 86.5 | 127,393 |
| Year 7 - FY 13/14 | 1,103 | 40 | 884 | 733 | 370 | 66% | 126.8 | 172,988 |
| Year 8 - FY 14/15 | 1,218 | 40 | 961 | 661 | 557 | 54% | 161.8 | 244,781 |
| Year 9 - FY 15/16 | 1,468 | 33 | 897 | 595 | 571 | 41% | 136.8 | 152,531 |
| Year 10 - FY 16/17 | 1,545 | 45 | 1,018 | 591 | 527 | 38% | 180.1 | 176,953 |
| Year 11 - FY 17/18 | 1,545 | 38 | 685.9 | 422 | 859.1 | 27% | 131.8 | 192,200 |
| Total | | | | | | | 98.8 | 136,569 |

Source: Author, 2024

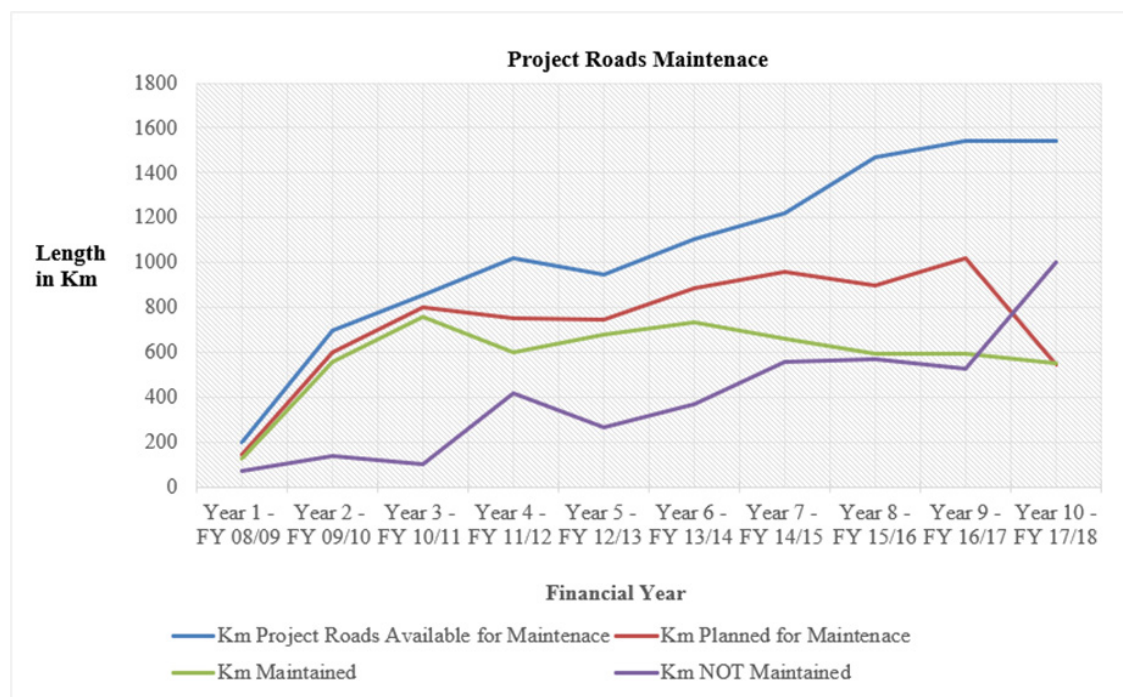


FIGURE 2
Showing comparison of Km improved versus maintained in the various financial years
Source: Author, 2024

that the amount of Phase 1 roads planned for maintenance decreased from 726 Km to 676 Km. At the end of that FY, only 661 Km or 69% of the planned 961Km received maintenance.

For FY 2015/16, a total of 897 Km of project improved roads out of an available 1,468 Km were planned for maintenance at a total budget of Kshs 202 Mill. Kirinyaga, Kiambu and Nyandarua regions commenced PBRM contracts for the Batch 2 gravel project improved roads. Ksh.136.82 Mill was used to maintain a total of 595 Km of the project improved roads or 66% of the 897 Km length planned for maintenance.

For FY 2016/17, a total of 1,018 Km of project improved roads out of an available 1,545 Km has been planned for maintenance at a total budget of KSHS 257 Mill. Kirinyaga, Kiambu, Nyeri and Nyandarua regions continued with the implementation of PBRM contracts for the project improved roads. The six regions of Murang’a, Nyandarua, Kiambu, Kirinyaga, Nyeri, and Laikipia maintained a total of 597 Km of the project improved roads or 59% of the 1,018 Km length planned for maintenance.

For FY 2017/18, 686Km out of 1,568Km of project improved roads had been planned for

maintenance at a total budget of Kshs 234 Mill. Apart from Batch 2 LVS where contracts had an inbuilt PBRM contracts, only Nyeri and Kirinyaga regions implemented PBRM contracts for the project improved roads. 423 Km were maintained at a cost of Kshs. 131.8 Mill.

Cost of Performance Based Maintenance of Project improved roads

During the Financial Year 2012/13, Murang’a and Nyandarua Regions contracted twenty-seven performance based routine maintenance contractors for a period of six months to maintain all the Phase 1 Batch 3 roads, a total length of 211 Km. The works commenced in December 2012 and were completed in September 2013. The average cost for the performance based off carriageway maintenance was Kshs 62,000 per Km or 10,000 per Km per month. Additional instructed works including gravel patching, culvert works and protection works. Emergency maintenance was allocated on average 165,000 Kshs per Km but were reduced to Kshs 120,000 per Km during implementation. The details of these performance contracts are summarised in **Table 9**.

During the financial years 2013/14 & 2014/15, **Table 10** provides the summary of the maintenance contracts for both Phase 1 Batch 3 and Phase 2

TABLE 9
 Performance based routine maintenance contracts FY 2012/13

| Regions | Contracts (No.) | Road Length (Km) | Period (Month) | Performance Based Contract Amounts (Kshs) | | Instructed Works (Kshs) | | Total Cost (Kshs) | |
|-----------------------|-----------------|------------------|----------------|---|---------------|-------------------------|----------------|-------------------|----------------|
| | | | | Cost | Cost per Km | Cost | Cost per Km | Cost | Cost per Km |
| Murang'a | 16 | 133.3 | 6 | 8,660,595 | 10,828 | 18,785,869 | 140,929 | 27,446,464 | 205,900 |
| Nyandarua | 11 | 77.7 | 6 | 4,403,975 | 9,447 | 6,703,301 | 86,272 | 11,107,276 | 142,951 |
| Total/ Average | 27 | 211 | 6 | 13,064,570 | 10,320 | 25,489,170 | 120,802 | 38,553,740 | 182,719 |

Source: Author, 2024

TABLE 10
 Performance Based Routine Maintenance Contracts FY 2013/14 and 2015/16

| Regions | Imple-mented Length (Km) | Con-tracts (No.) | Contract Road Length (Km) | Performance Based Contract Amounts (Kshs) | | Instructed Works (Kshs) | | Total Cost (Kshs) | |
|------------------------------|--------------------------|------------------|---------------------------|---|----------------|-------------------------|----------------|--------------------|----------------|
| | | | | Cost | Cost per Km | Cost | Cost per Km | Cost | Cost per Km |
| Phase 1 Batch 3 | | | | | | | | | |
| Murang'a | 77.8 | 8 | 78.8 | 9,931,830 | 126,038 | 11,567,055 | 146,790 | 21,498,885 | 272,828 |
| Nyandarua | 135.5 | 10 | 138.9 | 18,054,419 | 129,981 | 41,147,415 | 296,237 | 59,201,834 | 426,219 |
| Total/ Average | 213.3 | 18 | 217.7 | 27,986,249 | 128,009 | 52,714,470 | 221,513 | 80,700,720 | 349,523 |
| Phase 2 Batch 1 | | | | | | | | | |
| Kiambu | 59.7 | 8 | 54.8 | 7,907,838 | 144,303 | 9,099,870 | 166,056 | 17,007,708 | 310,359 |
| Kirinyaga | 23.3 | 4 | 23.5 | 2,988,207 | 127,157 | 4,776,240 | 203,244 | 7,764,447 | 330,402 |
| Nyeri | 35.9 | 7 | 48.1 | 7,487,462 | 155,599 | 12,076,864 | 250,973 | 19,564,326 | 406,573 |
| Murang'a | 8.4 | 1 | 8.4 | 3,288,600 | 180,098 | 1,135,800 | 62,201 | 4,424,400 | 526,714 |
| Laikipia | 18.2 | 2 | 18.2 | 1,138,530 | 135,539 | 1,702,200 | 202,642 | 2,840,730 | 156,084 |
| Total / Average | 145.5 | 22 | 153.0 | 22,810,637 | 148,539 | 28,790,974 | 177,023 | 51,601,611 | 346,026 |
| Grand Total / Average | 358.8 | 40 | 370.7 | 50,796,886 | 138,274 | 81,505,444 | 199,268 | 132,302,331 | 347,775 |

Source: Author, 2024

improved roads for the 18 months performance-based routine maintenance contracts. The Phase 1 roads were packaged into 18 contracts while Phase 2 were packaged into 22 contracts. These works were procured in January 2014 and commenced between March and May, 2014. The Phase 1 roads cost on average Kshs 349,500 per Km to maintain for 18 months (233,000 Kshs/Km/Year) while the improved Phase 2 Batch 1 roads cost on average 325,500 per Km (217,000 Kshs/Km/Year). The

total cost of maintaining the contracted 371 Km for 18 months was Kshs 132.3 Mill.

CONCLUSIONS AND RECOMMENDATIONS

The study made the following findings:

- (i) The budget allocations towards maintenance were increased as the road lengths available for maintenance increased, as more roads were handed over for maintenance upon

- improvement by the Roads 2000 program.
- (ii) The budget allocations per unit road length increased from Kshs 55,984 in the FY 08/09 to as high as Kshs 244,781 in the FY 14/15, and was observed to be Kshs 192,200 in the FY 17/18. This corresponds to the increase in the number of performance-based routine maintenance contracts, which rose from 20 in the FY 10/11 to as high as 45 in the FY 16/17.
 - (iii) As more roads were put under performance-based routine maintenance through incorporation of additional contracts, the road length under maintenance reduced, and the unmaintained road length increased. This was adduced to the improved service levels sustained, meaning that few roads required constant maintenance with continued incorporation of performance-based contracting.
 - (iv) At the onset of incorporating performance based routine maintenance, there was a marked increase in cost of continuous maintenance per unit length. This was however expected to reduce in the life cycle of the design period of the road.
 - (v) Site visual inspections of the roads under performance based routine maintenance showed roads in good serviceability. However, the roads that were not put under the performance contracting exhibited different forms of deterioration like developed potholes and lack of visibility owing to uncleared bushes.
 - (vi) The good serviceability on roads under performance based routine maintenance could be owed to the short turn-around time in maintenance, as defects are corrected as soon as they occur. This is however not the case for the conventional road maintenance methods.

It was concluded that adoption of performance based routine maintenance contracting had a positive impact in increasing the level of prioritisation for maintenance, where additional resources were allocated per unit length of road per year. As has been the case in the local authorities in Kenya, where opening up of roads was always given the first priority, to the detriment of maintaining already improved roads, a significant shift in strategy was observed. In addition, incorporating maintenance planning from the initial stage of road implementation has

been proven to be worthwhile in maintaining the improved infrastructure in the best condition possible.

It is recommended that monitoring of service levels need to be well defined on the contracts, and easy and straightforward methods need to be adopted. In addition, completed projects under PBC needed to be well documented, for ease of tacking challenges and lessons learnt. Further research on level setting for low volume sealed roads, especially gravel sealed roads, is recommended.

CITED REFERENCES

Asian Development Bank (ADB), (2018). *Guide to Performance-Based Road Maintenance Contracts*. Manila: Central Asia Regional Economic Cooperation (CAREC).

Berhane G., (2023). *Applicability and Cost Implication of Labour-Based Methods for Sustainable Road Maintenance (SRM) in Developing Countries*. Hindawi: Advances in Civil Engineering.

Gelderman C. J., J. Semeijn, S. D. Vries, (2019). Contracting for Road Maintenance in the Netherlands - The Downside of Performance-Based Contracting. *Infrastructures*, 4(41) doi:10.3390/infrastructures4030041.

Japan International Corporation Agency (JICA), (2016). *Performance Based Road Maintenance Contract (PBC) Guideline*. Nairobi: Ministry of Transport and Infrastructure.

Kenya National Bureau of Statistics (KNBS), (2023). *Economic Survey 2023*. Republic of Kenya: Government printers

Kenya Roads Board (KRB), (2023). *Strategic Plan for Financial Years 2023/24– 2027/28*. Republic of Kenya: Government printers

McDonald, R., M. Roland, (2009). *Pay for performance in primary care in England and California: Comparison of Unintended Consequences*. Manchester, United Kingdom: National Primary Care Research and Development Centre, The University of Manchester,

Mostafa H. M., (2018). *Road Maintenance in Africa: Approaches and Perspectives.* Sustainable Roads, Urban and Transportation (SURT) Research Group. Central University of Technology, South Africa: Department of Civil Engineering

Mulmi A. D., (2016). Assessment of Performance-Based Road Maintenance Practices in Nepal. *Open Journal of Civil Engineering.* 6(2), 225–241.

Permanent International Association of Road Congresses (PIARC) (1994). Areas and Drainage. *International Road Maintenance Handbook: Practical Guidelines for Rural Road Maintenance,* 1-4

Prasad, S, Hammaker, J. Quant, K. Glandon, (2022). *Use of Performance-Based Contracts for Road Maintenance Projects: A Rapid Evidence Assessment.* Washington, D.C: International Initiative for Impact Evaluation.

Sally B., N. Stankevich, (2005). *Why Road Maintenance Is Important and How to Get It Done.* Washington, DC: The World Bank

Simoes D., A. Almeida-Costa, and A. Benta, (2017). *Preventive Maintenance of Road Pavement with Micro Surfacing – An Economic and Sustainable Strategy.* *International Journal of Sustainable Transportation.* 11(9), 670–680,

The World Bank, (2022). *Assessing Economic Efficiency of Long-Term Road Asset Management Strategies.* Washington DC: International Bank for Reconstruction and Development / The World Bank. Supported by the QII Partnership.

Yonghong Y., H. Lan, W. Jiecong, and X. Yuanbo, (2015). Research on reference indicators for sustainable pavement maintenance cost control through data mining. *Sustainability.* 11(3), id 877, 2019.

Zietlow G., (2017). *Performance Based Road Maintenance Contracts. – Reference Note.* Manila: The Central Asia Regional Economic Cooperation (CAREC) Transport Knowledge Series