Analysing the Evolution of Kenya’s Road Network since the 1950s using Historical and Contemporary Road Datasets

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Abstract

Kenya’s road network has undergone substantial but uneven transformation since the 1950s. This study compares historical road data derived from topographic maps using a deep learning-based extraction method with contemporary datasets from the Kenya Roads Board, in order to trace long-term development patterns and regional disparities. To evaluate national progress and identify persistent structural gaps, changes in total road length and shifts in the average distance to the nearest road are calculated as primary indicators. Additionally, road expansion has been linked to population growth showing where infrastructure has lagged behind demographic change and where investments have been disproportionately high. A regional analysis of selected areas in southwestern Kenya between the 1950s and 1980s further illustrates contrasting development trajectories shaped by political priorities and settlement patterns. The results show that the southwestern, central, and coastal regions benefited from greater investment, while arid and sparsely populated northern counties remained underserved. Despite major improvements, spatial inequalities persist and rapidly growing urban centres, such as Nairobi, face challenges as population growth outpaces road expansion. It can therefore be concluded that Kenya’s road development has not followed the principle of spatial equity, emphasising the need for targeted interventions to address historical marginalisation and the demographic pressures present in rapidly growing urban regions.

1. Introduction

The development of roads in Kenya has been influenced by a complex history shaped by colonial priorities, post-independence state-building, and contemporary ambitions for national integration. Early road construction mainly focused on administrative centres and important trade corridors, reflecting the logic of colonial control rather than territorial cohesion. Prior to colonial rule, mobility in the region followed the caravan routes used for ivory and slave trading and formal road construction only began at the turn of the twentieth century with Sclater’s Road, a rudimentary wagon track linking Mombasa to Kisumu (Smith, 1899). However, progress in road construction remained slow, with the first motorised journey between Mombasa and Nairobi not being completed until 1926. Hard-surfaced roads were initially only available in Nairobi in the 1920s, followed by other major towns of the country in the 1930s (Park, 2014). This early network overwhelmingly served urban centres and colonial administrative hubs, while vast rural regions, particularly the Northern Frontier District (NFD), were dismissed as economically unviable due to sparse populations, arid landscapes, and predominantly pastoral livelihoods (Kochore, 2016).

From a historical perspective, the first major expansion of Kenya’s road network came in the 1940s and 1950s, driven as much by military imperatives as by economic considerations. Wartime mobilisation and the Mau Mau rebellion created strong incentives for the colonial state to improve transport corridors (Park, 2014), deploy military surveyors, and invest in aerial mapping (McCormack, 2009), all of which accelerated road construction and cartographic coverage of the infrastructure. However, roads in rural areas often remained little more than dirt tracks, maintained through forced labour, an unpopular system that was widely resented by local communities (Park, 2014). Without regular use, these tracks quickly deteriorated or became overgrown (Greiner, 2022). It was only with the rise of commercial agriculture and expanding market integration that rural communities began to view roads as assets rather than instruments of coercion. This shift was shaped by ecological conditions, wildlife pressures, and changing land-use dynamics (Epps et al., 2015). Since the early 2000s, Kenya has pursued an ambitious infrastructure agenda through programmes such as Kenya Vision 2030, emphasising road upgrades, regional connectivity, and economic transformation (Kenya Roads Board, 2023). Despite substantial investments, persistent challenges, including maintenance deficits, congestion, funding constraints, and pronounced regional disparities, continue to limit the network’s performance and equity (The World Bank, 2018). These contemporary issues cannot be understood without situating them within the longer history of uneven development that has shaped Kenya’s transport landscape.

To identify structural gaps and assess progress towards achieving national development goals, including Kenya Vision 2030 and the Sustainable Development Goals (SDGs), it is crucial to understand how Kenya’s road network has developed over the past seven decades. This study presents a spatially explicit nationwide analysis of road network evolution from 1950 to 2020 by comparing digitised historical road data with contemporary infrastructure data. A nationwide road network from the period 1950 to 1980, extracted from historical topographic maps using deep learning-based methods (Kramm et al., 2025b,a), has been compared with a modern road inventory from the Kenya Roads Board covering the year of 2020 (Kenya Roads Board, 2020). The goal is to assess long-term changes in accessibility and to highlight regional disparities in road development. To capture finer temporal dynamics, two additional historical datasets were extracted from topographic maps for seven regions in southwestern Kenya, one covering the period from the 1950s to mid-1960s and the other covering the period from the 1970s to 1980s. These datasets enable a detailed analysis of road network development between the 1950s and 1980s in these selected areas. Geographic Information System (GIS)-based metrics, including the length of newly built roads and the change of the average distance to the nearest road between mid-twentieth century and 2020, are used to quantify spatial and temporal patterns of development. Furthermore, the evolution of the road network is compared with population growth during this period in order to identify areas with a potential infrastructure deficit or over-proportional road investments during the last 70 years. By examining Kenya’s road development over seven decades, it is the aim to highlight structural gaps and persistent inequalities in infrastructure development across different regions.

2. Materials & Methods

2.1 Historical Topographic Maps

Most of the topographic maps used in this study were sourced from multiple institutions in both Kenya and the United Kingdom. All sheets were originally produced and published between the 1950s and the late 1980s (Directorate of Overseas Surveys et al., 1948-, 1955-). In total, more than 600 map sheets were used to extract Kenya’s historical road network. The majority of maps were obtained in Kenya, primarily from the Survey of Kenya, the national authority for topographic mapping, with additional sheets from the survey and urban planning departments of several local county governments. 449 map sheets at a scale of 1:50,000 and 71 sheets at a scale of 1:100,000 were collected from Kenyan repositories. A subset of these materials, 166 of the 1:50,000 sheets and 94 of the 1:100,000 sheets, were available only as clipped data frames lacking publication metadata. Some additional sheets consisted of technical drawings rather than fully standardised topographic maps, but they still contained usable road information and were therefore included. Figure 1 shows an overview of the coverage grid of 1:50,000 and 1:100,000 map sheets across the country.

As it was not possible to achieve complete national coverage from Kenyan sources alone, additional sheets were obtained from British archives holding historical collections produced and published by the Directorate of Overseas Surveys (DOS) and the War Office, General Staff, Geographical Section. Nine sheets covering the Lake Baringo region were purchased from the Cambridge University Library. To achieve dense coverage for the 1950s–1960s in southwestern Kenya, further sheets from this period were acquired from the Bodleian Library at the University of Oxford. Complementary material from the 1970s–

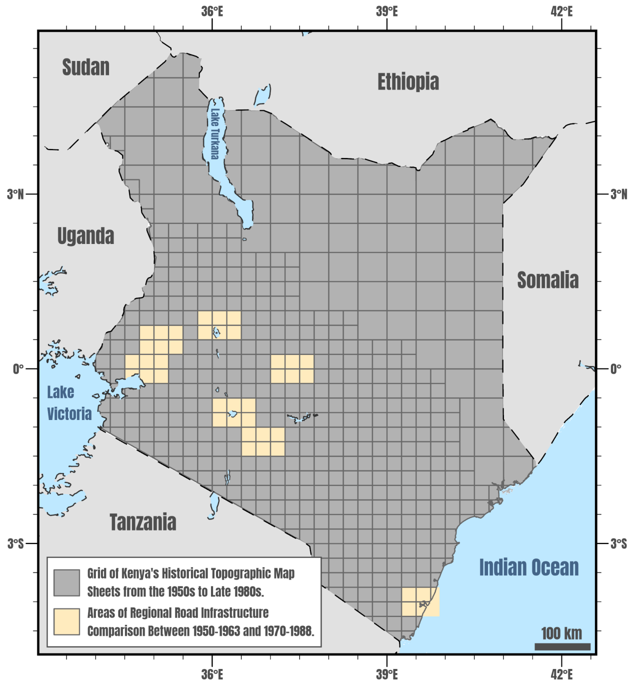

Figure 1. Grid of the topographic maps used in this study, spanning the 1950s to the 1980s. Each square represents an individual map sheet, with larger squares indicating maps at a scale of 1:100,000 and smaller squares corresponding to the 1:50,000 scale. Highlighted sections mark the areas selected for additional regional analysis of mid-20th-century road network development.

1980s was sourced from publicly accessible collections, including the Stanford University digital archive (Stanford Geospatial Center, 1957), the SamSamWater map repository (SamSamWater, 2025), and the European Soil Data Centre (ESDAC) (Panagos et al., 2011).

2.2 Deep Learning-based Extraction of Historical Roads

All roads were extracted using deep learning-based techniques according to the workflow described in detail in Kramm et al. (2025a). All digitised topographic maps were imported into ArcGIS Pro and manually georeferenced to the Arc 1960 UTM coordinate system. Depending on the map’s location, the appropriate UTM zone (36N, 37N, 36S, or 37S) was applied. Georeferencing primarily relied on the official 1:50,000 and 1:100,000 Topographical Index Grid provided by the Survey of Kenya, ensuring consistent alignment of sheet boundaries. For maps containing internal coordinate grids, additional control points were added to improve the positional accuracy. The second step was to categorise the maps into groups based on their style and symbology. All sheets contained three road classes: ”Main Roads” with a bound surface, ”Secondary Roads” with a loose surface, and ”Dry Weather Roads”, which are only passable under favourable conditions and with suitable off-road vehicles. However, the symbols used to represent these classes differed depending on the edition and source. As each road class could be represented differently on different maps, individual classifications were required for each road representation. A ground truth dataset was manually created in ArcGIS Pro for each symbol type. A 20 m buffer was applied to ensure that the entire width of the road printed on the map was captured during model training. The training data was exported as 512×512 pixel image tiles with a 128 x 128 pixel overlap using the ”Export Training Data for Deep Learning” tool. Depending on the length of each road type, between 900 and 8,400 tiles were generated per class.

Model training and classification were automated using a Python script (Kramm, 2025). To train a model for each road symbol type, the ArcGIS Pro tool ”Multi-Task Road Extractor” was used with a ResNet34 backbone and a U-Net segmentation architecture. The optimal learning rate was automatically determined, and training ran for up to 50 epochs with early stopping. The trained models were then applied to all relevant map sheets using the ”Classify Pixels Using Deep Learning” tool to create binary raster classifications for each road type and map where this road type occurred. All classified rasters were subsequently converted to polygons and then to centerline vectors. All extracted segments were then merged into a seamless dataset, with each feature assigned to its corresponding road class. Minor misclassifications were automatically removed, and small gaps within road segments were filled using polygon simplification tools. Topological corrections were performed using the ”Trim Line” and ”Extend Line” tools to resolve overshoots, undershoots, and disconnected intersections. Finally, a manual review of the entire dataset ensured that any remaining artifacts were removed and any missed or misclassified road segments were corrected. The resulting datasets include the three road classes based on the original map symbology.

The accuracy of the extracted road segments in the nationwide dataset was determined in Kramm et al. (2025a) with an average F1-Score of 0.84 ranging between 0.79 and 0.95. Since the additional roads for regional comparison in seven selected areas were extracted from topographic maps of similar quality and style, it can be assumed that their original extraction accuracy is in a similar range. However, since all datasets subsequently underwent extensive manual corrections, their actual accuracy can be considered a near-perfect match compared to the original map sources. Nevertheless, the accuracy of the extracted road dataset may be affected by several additional limitations that cannot be quantified. Positional errors can occur during georeferencing, and the accuracy and completeness of the roads depends heavily on the quality of the original maps. Cartographic generalisations, incomplete source data, and distortions caused by scanning or poor preservation of the maps can lead to discrepancies that are not classification errors but inherent flaws in the historical material. It is also important to recognise that historical maps are not neutral documents and may reflect the priorities and biases of their creators (Crampton, 2001). Consequently, some existing roads may remain unmapped due to prolonged conflicts and crises, particularly in marginalised areas of Kenya.

2.3 Nationwide Analysis of the Road Network Evolution from mid-20th Century to 2020

The study is based on a nationwide historical road dataset for Kenya developed by Kramm et al. (2025a) and derived from 1:50,000 and 1:100,000 topographic maps dating from the 1950s to the 1980s. This dataset was created using deep learning-based feature extraction techniques and provides a foundation for examining long-term changes in Kenya’s transport network. To assess change over time, the mid-twentieth-century road data was compared with the 2020 national road inventory compiled by the Kenya Roads Board (KRB) (Kenya Roads Board, 2020), which documents 161,439 km of contemporary roads. All analyses were conducted in ArcGIS Pro. The road length has been calculated for each road segment using ArcGIS Pro’s geometric processing tools, enabling the estimation of newly constructed road kilometres at both the national scale and the level of individual map sheets. This approach provides a more regionally differentiated understanding of where substantial road development has occurred. Additionally, the average distance to the nearest road was computed for each map sheet for both datasets using ArcGIS Pro’s “Near” tool. This metric offers insights into changes in road density and accessibility over time, highlighting areas where improvements have been most pronounced.

To identify regions that were comparatively under- or overrepresented in terms of road development during this period, the study additionally examines the relationship between road construction and population dynamics. This was achieved by comparing the length of newly built roads with the population growth between 1975 and 2020. Population data were obtained from the Global Human Settlement “GHS Population Grid Multitemporal” datasets for the years 1975 and 2020 (Pesaresi et al., 2024). This dataset provides gridded estimates of human population as the number of people per cell. These values were aggregated for each map sheet, and the difference between the two years was calculated to derive the population growth for each sheet’s extent.

To ensure comparability between variables, both the length of road construction and the population growth were standardised using a Z-Score transformation. This rescaling sets each variable to a mean (μ) of 0 and a standard deviation (σ) of 1, using the formula:

$$z = \frac{x - \mu}{\sigma} \tag{1}$$

This transformation removes the influence of differing units and scales, enabling a direct comparison of the relative intensity of development across the grid. To simultaneously visualise the spatial interaction between road construction and population growth, a bivariate relationship map was produced. This approach highlights four characteristic development typologies:

- Stagnant areas where both road expansion and population growth remained low.
- Infrastructure-led areas with high levels of road construction but limited population growth.
- High-pressure areas where population growth was rapid despite limited road investment.
- High-growth areas that experienced both substantial road building and strong population growth.

To further quantify the extent to which road development has outpaced or lagged behind demographic change, an Ordinary Least Squares (OLS) regression was performed. In this model, the standardised road construction serves as the dependent variable, while standardised population growth acts as the explanatory variable. Positive residuals indicate areas of an overproportional road development, where more roads have been built than the national population trend predicts. In contrast, negative residuals reveal areas where infrastructure lags behind the predicted growth. To determine whether these imbalances are random or follow a systematic geographical pattern, the Global Moran’s I was calculated using the ”Spatial

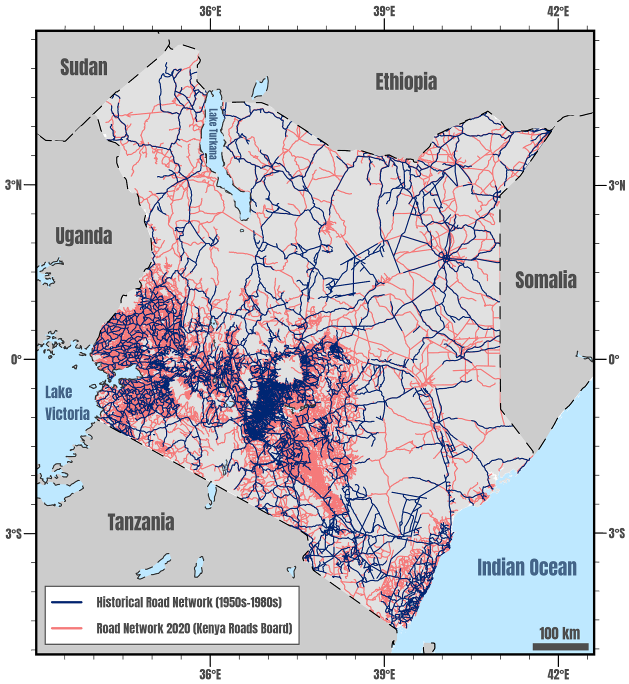

Figure 2. Differences between the extracted historical road network of Kenya and the current status of roads from the Kenyan Roads Board dataset to illustrate the evolution of the road network over the last decades.

Autocorrelation (Global Moran's I)" tool in ArcGIS Pro. This validates whether road developments in Kenya are part of a broader, non-random regional trend by determining if patterns are clustered, dispersed, or occurring randomly. The spatial relationship among the features was defined using "contiguity by edges and corners".

2.4 Regional Analysis of the Road Network Evolution between 1950s and 1980s

To achieve a clearer temporal differentiation within the historical period, two additional road networks were extracted for seven selected areas in southwestern Kenya (Figure 1). This was done using additional topographic maps and the deep-learning methodology described above. These areas, located in the southern and southwestern parts of the country, were chosen because they encompass a diverse mix of urban centres and predominantly rural landscapes. The resulting regional datasets represent two narrower time periods, one covering the 1950s to mid-1960s, and the other covering the 1970s to 1980s. This allows for a more detailed assessment of road development trajectories within these zones. Both historical datasets classify roads according to the original topographic map symbology into the three categories: Main Roads, Secondary Roads, and Dry Weather Roads. Comparing these classes not only documents newly constructed roads, but also identifies potential upgrades to existing infrastructure in these areas.

3. Results

3.1 Nationwide Evolution of Kenya's Road Network

The results show a profound transformation of Kenya's road infrastructure over the past decades. Figure 2 shows visual

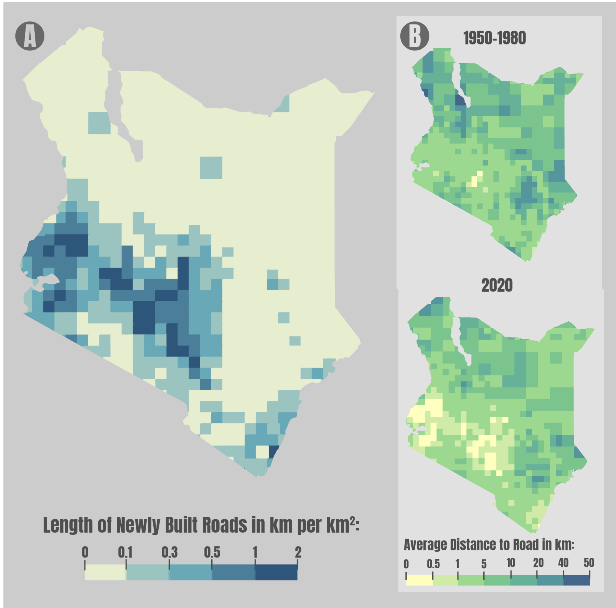

Figure 3. A) Length of newly built roads (in km) per km² in Kenya between mid-20th century and 2020, calculated for the area of each map sheet. B) Average distance to a road in km for the 1950s–1980s and 2020.

overlays of the historical and contemporary networks, illustrating roads that have persisted since the mid-twentieth century (blue) alongside those constructed in subsequent decades (red). The overall network density has increased substantially, and the total road length has roughly tripled, with an estimated 105,000 km of new roads built since the 1980s. Figure 3 (A) shows that this expansion has been far from uniform across the country. The most pronounced growth has occurred in the southern and central regions, where road density has increased significantly. In contrast, northern and arid regions, particularly the NFD, remain sparsely connected, reflecting long-standing spatial inequalities in infrastructure investment. These disparities are also evident in the mean distance to the nearest road. In the historical dataset (1950–1980), the average distance to a road was 8.6 km, decreasing to 5.1 km in the 2020 network. However, the most substantial reductions in distance occurred in southwestern Kenya, while northern regions experienced only modest improvements (Figure 3 (B)).

Comparing road development with population growth during that period reveals a clearer picture of over- and underdeveloped areas. Figure 4 (B) shows that the primary population growth mainly occurred in the southwestern regions of Kenya. However, the Mombasa region and the northeastern part of the country also experienced significant population growth. Combining road development and population growth in a bivariate relationship map in Figure 4 (C) reveals that the northeastern Region has particularly faced a structural deficit in road development relative to its population growth. In contrast, the southwestern region shows strong population growth alongside substantial investments in road infrastructure. The OLS regression was used to model the national trend in road construction based on population growth. The resulting standardised residuals identify areas where the actual road expansion deviates from the predicted trend (Figure 4 (A)). Positive residuals are predominantly found in several regions of the southwestern corridor, particularly to the north and east of Nairobi, in the Lake Nakuru area, and the region of Eldoret, suggesting the need for proact-

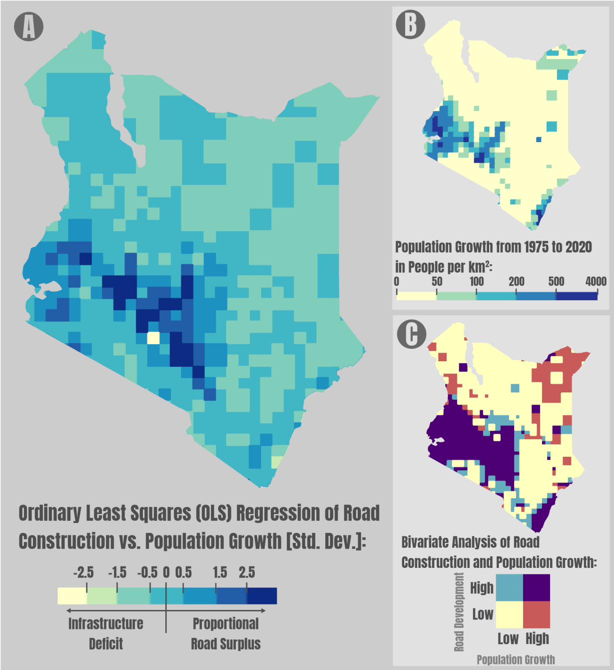

Figure 4. A) Ordinary Least Squares regression of standardised road construction and population growth between 1975 and 2020, indicating areas of infrastructure deficit and over-proportional road development. B) Population growth in people per km² between 1975 and 2020 derived from the Global Human Settlement Datasets “GHS Population Grid Multitemporal”. C) Bivariate mapping of standardised increase in road length and population growth.

ive infrastructure investment in these regions. Negative residuals dominate in the northern and eastern regions, indicating an infrastructure deficit in these areas. Nevertheless, the calculated regression reveals the highest infrastructure deficits in the Nairobi region. Despite having one of the highest proportions of newly built roads, Nairobi stands out as the area with the highest infrastructure deficit relative to its population growth.

To validate whether these imbalances represent localised anomalies or broader regional trends, a Global Moran’s I test was performed on the OLS regression residuals. The analysis revealed a Moran’s index of 0.5, a Z-Score of 23.83, and a p-value of < 0.0001. This exceptionally high Z-Score indicates significant spatial clustering of both infrastructure surpluses and deficits. A Moran’s Index of 0.50 further confirms a strong positive spatial autocorrelation, meaning that grid cells with high residuals tend to be geographically clustered together.

3.2 Regional Comparison of Kenya’s Road Network

A regional comparison of road datasets from the 1950s/60s and 1970s/80s, covering seven regions in southwestern Kenya and 42 map sheets in total, shows a substantial road network expansion of about 89%, from 4,693 km to 8,904 km. The results also indicate significant road upgrades. The amount of dry weather roads increased in length from 2,793 km to 3,273 km, but their relative share dropped from 59% to 37%, while secondary roads rose from 1,525 km (32%) to 3,403 km (38%). The proportion of main roads also substantially increased from 374 km (8%) to 2,227 km (25%) in the 1970s/80s.

Comparing the evolution of roads in these seven selected areas reveals significant regional differences in road development

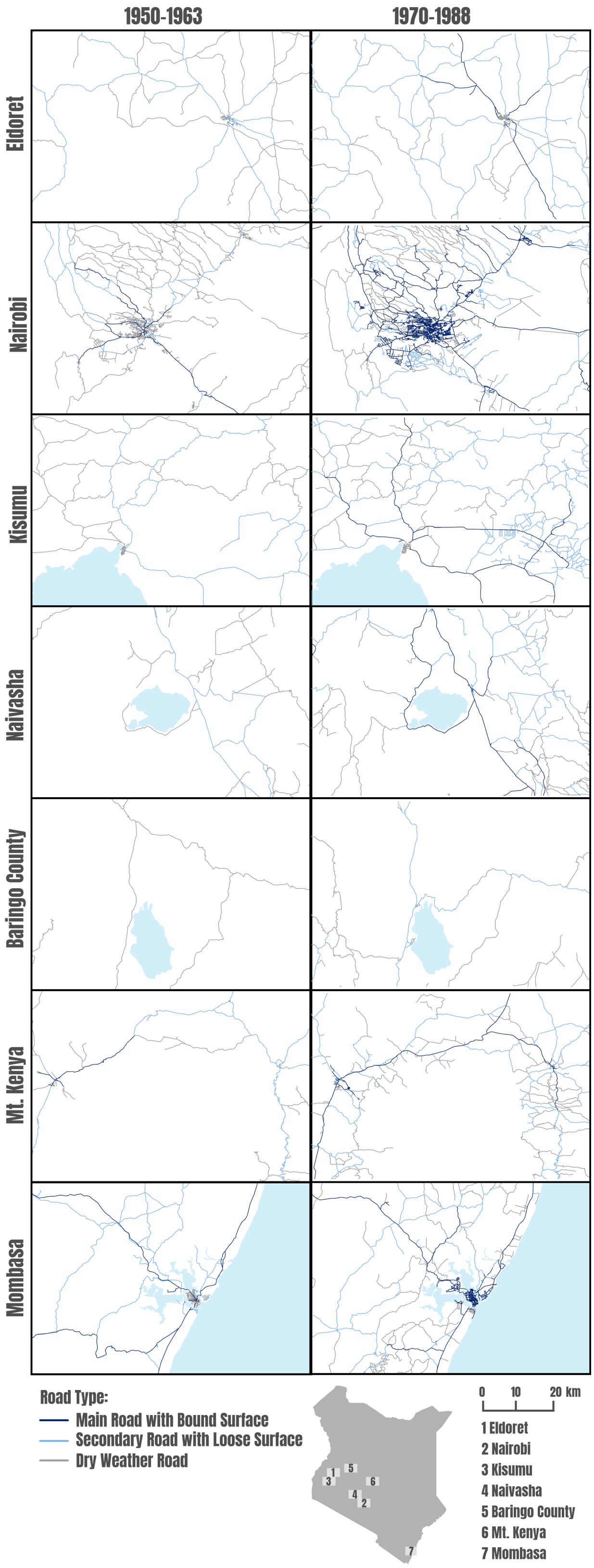

Figure 5. A visual comparison of the extracted road infrastructure for seven selected areas from 1950–1963 and 1970–1988.

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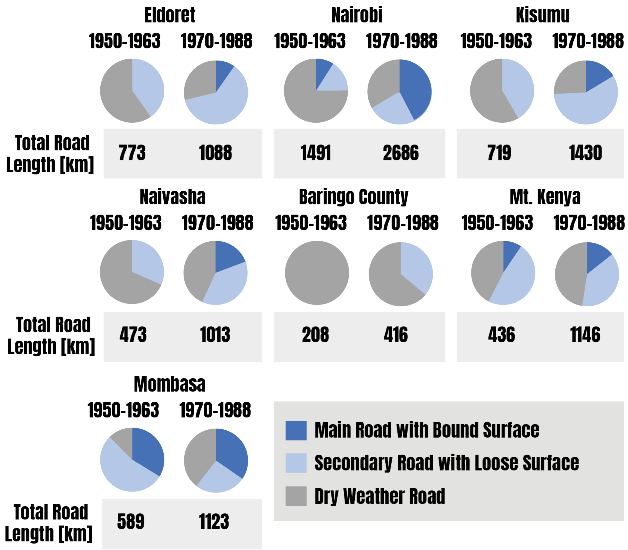

Figure 6. Statistical comparison of extracted road infrastructure length and the proportions in the different classes for seven selected areas from 1950–1963 and 1970–1988.

of the mid-20th century (Figure 5). Figure 6 shows that the Nairobi region had the highest road length in the 1950s/60s (1,491 km), which increased by around 80% to 2,686 km by the 1980s. With the highest average population density (254 people/km² in 1975), the Nairobi region saw a strong rise in main roads with a bound surface rising from 9% to 42%, while the proportion of dry weather roads fell from 75% to 33%. The regions of Mombasa and Kisumu had the next-highest population densities (199 and 180 people/km² respectively). Mombasa's 589 km network in the 1950s/60s already included about one third of main roads and relatively few dry weather roads (12%). In contrast, Kisumu had slightly more roads (719 km), but none of them were paved. In the following decades, in Mombasa mainly dry weather roads were added and the region saw fewer investments in higher-tier roads compared to Kisumu. Main roads were mainly built in Mombasa's urban area, while the surrounding regions received limited investments in higher tier roads. In contrast, Kisumu saw a major growth in main roads (+234 km) and secondary roads (+528 km), with dry weather roads declining from 420 km to 368 km, indicating substantial new construction and road upgrades in this region.

The region of Eldoret had a population density of 109 people per km² in 1975. However, it experienced the smallest increase in road length, growing from 773 km to 1,088 km (+40%). Only 105 km of new main roads were added, while the proportion of secondary roads increased from 40% to 61%, and dry weather roads decreased from 59% to 29%. This suggests that many existing roads in this region were upgraded. Lake Naivasha and Mt Kenya had relatively low population densities in 1975, with 53 and 73 people per km² respectively. Despite their low population densities, these regions saw disproportionately large road expansions. Mt. Kenya's network grew from 436 km to 1,146 km (+162%), and Lake Naivasha's from 473 km to 1,013 km, including 195 km of new main roads. The most rural region considered in this study is Baringo County. It had a population density of only 8 people per km² in 1975. Consequently, it had the lowest road density in the 1950s/60s, with only 208 km of dry weather roads and no higher-tier roads. Its network doubled to 416 km by the 1970s/80s, but still lacked paved main roads, with only 150 km classified as secondary roads and most remaining dry weather roads.

4. Discussion

Kenya's road network has evolved significantly over the past seven decades, but persistent regional disparities remain. The total length of roads has tripled, and the proportion of paved and upgraded roads has grown substantially, reflecting a major transformation in connectivity. Our analysis shows that these disparities already existed in the mid-twentieth century. The historic nationwide road network from this study indicates a paved road density of 8.6%, while the regional analysis in areas with more active road development showed a proportion of 25% paved roads in south-southwestern Kenya during the 1970s and 1980s, which is notably higher than the national average. According to the final report of the 2nd Road Sector Investment Programme (2018–2022) by the Kenyan Road Board, approximately 15% of the current road network is paved to date (Kenya Roads Board, 2018). A study by Zhou et al. (2024), based on OpenStreetMap data, estimated that 30% of Kenya's roads are paved, with significant differences between urban areas, which have more paved roads, and rural areas with predominantly unpaved roads. Nevertheless, Kenya's ratio of paved to unpaved roads remains below the overall African average of 47% paved roads (African Development Bank Group, 2014).

When analysing the results, it should be considered that there is likely to be some uncertainty regarding the completeness of the datasets being compared. Some roads that are classified as newly built may already have existed in rudimentary or informal form, but were not captured in historical maps. Likewise, the current Kenya Roads Board dataset may not be fully comprehensive, and its overall accuracy is not documented. Nevertheless, the overall growth of the road network analysed in this study appears consistent from a historical and political perspective.

The results show that road investments have been unevenly distributed across the country. The southwestern, central, and coastal regions have benefited far more than the arid and sparsely populated north. Comparing road expansion with population growth highlights the structural nature of these disparities. While population growth has been concentrated in the southwest, Mombasa, and parts of the northeast, the latter has not seen commensurate infrastructure investment. Notably, even Nairobi, despite receiving one of the highest absolute increases in road length, emerges as the region with the greatest infrastructure deficit relative to population growth, illustrating the pressures of rapid urbanization. However, Nairobi's negative residual does not signify a lack of investment, but rather illustrates the infrastructure lag inherent in hyper-urbanising environments. The city's vertical growth and densification outpace the physical possibility of horizontal road expansion. Furthermore, this analysis does not capture the fact that urban infrastructure focuses on capacity enhancement (multi-lane roads) rather than additional road length. Therefore, negative OLS values in southern Kenya's urban clusters should not necessarily be interpreted as simple underinvestment. They signal the widening gap between limited physical space and intense demographic pressure, conditions in which horizontal road expansion reaches its practical limits.

The development of roads between the 1950s and 1980s in seven selected regions shows clear but uneven patterns, which were shaped by population density, historical starting conditions, and regional priorities. While the network expanded steadily from the 1950s onwards, its growth was significantly impacted by political interests, economic limitations, and uneven regional investments (Kiprono and Matsumoto, 2018). Nairobi remained the most developed area throughout the period, combining the highest initial road density with the strongest upgrading. This is reflected in the rise of paved roads from 9% to 42% and the sharp decline in dry weather roads. Despite similar population densities, the regions of Mombasa and Kisumu diverged significantly. Mombasa began with a relatively advanced network and saw limited expansion of higher-tier roads outside the city. In contrast, Kisumu started with no paved roads and underwent significant upgrades and substantial growth in both main and secondary roads. Eldoret had a modest population density but experienced the lowest relative growth in road length until the 1980s, with improvements focused more on upgrading dry weather roads than expanding the network. However, the comparison with the contemporary road data reveals the region of Eldoret as one of the regions with the highest infrastructure investment relative to population growth in recent decades. In contrast, the sparsely populated areas of Mt Kenya and Lake Naivasha saw disproportionately large increases in road length until the 1980s, suggesting targeted investments driven by economic or political factors rather than population-driven demand. Baringo County remained the least developed region, with its network dominated by dry weather roads and no paved roads even by the 1970s/80s. This highlights the persistent infrastructural marginalisation in very low-density areas. However, the election of local MP Daniel arap Moi to the presidency in 1989 resulted in the dramatic development of the rural road network and the construction of paved roads in his home area in Baringo County in the following years (Burgess et al., 2010).

Political forces heavily influenced Kenya's mid-20th-century road development. After independence in 1963, roads were promoted as a symbol of development, intended to connect rural communities to markets and services. However, from the 1970s onwards, road construction and maintenance increasingly followed patterns of political patronage. As shown by Burgess et al. (2010), road allocation became deeply tied to ethnicised politics, with regions lacking influence in government receiving little investment. This was most evident in the NFD, which was placed under military administration in the early 1960s and effectively excluded from meaningful infrastructure development for three decades. The few roads built there primarily served security purposes rather than facilitating civilian mobility (Weitzberg, 2017; Enns and Bersaglio, 2020). A major policy shift occurred in 2005, when the government committed to reversing decades of neglect through a World Bank–supported programme investing $1 billion over 13 years (The World Bank, 2018). At that time, Kenya's road network was poorly documented, and much of the historical cartographic material used in this study was scattered and inaccessible. Institutional reforms followed with the creation of three national road authorities, KeNHA, KURA, and KeRRA, to manage highways, urban roads, and rural roads respectively. Alongside these agencies, the National Government Constituencies Development Fund (NG-CDF), overseen by members of the parliament, also plays a role in road development. The NG-CDF finances certain designated roads that fall outside the mandates of county governments, KURA, or KeRRA. Established in 2003 as the Constituencies Development Fund (CDF) and renamed in 2015, the fund allocates resources based on local needs assessments and constituency priorities, resulting in significant variation in the extent of road development depending on the efforts of individual members of parliament. From 2010 onwards, county governments also assumed responsibility for secondary and minor roads. Initially, efforts focused on repairing deteriorated infrastructure (The World Bank, 2018), but in recent years there has been substantial new construction aligned with the Kenya Vision 2030 development agenda (Enns and Bersaglio, 2020). Although elite capture still affects some projects, and political alignments and electoral competitiveness continue to influence the allocation of road investments, this is less dominant than in earlier decades (Moseti et al., 2026). Previously neglected regions, including the north, are now receiving more sustained investment.

5. Conclusion

Analysing Kenya's historical and contemporary road networks reveals the lasting impact of colonial planning, which concentrated infrastructure in economically profitable and densely populated regions while neglecting areas considered unproductive due to sparse settlement, pastoral livelihoods, or ecological constraints. These disparities persist today, and the NFD is a classic example of this, in line with broader research showing how transport networks have long influenced the economic and political development of African states (Freed, 2010; Lamont, 2013). Since the 1960s, political decision-making has reinforced these uneven geographies, making road infrastructure both a marker of economic growth and an expression of state priorities.

The analysis of digitized historical road data alongside contemporary data highlights the value of a long-term, spatially explicit analysis for understanding infrastructure development. The combined datasets show that Kenya's road expansion has not followed principles of spatial equity. Instead, the findings confirm and deepen existing understandings of how road systems have shaped Kenya's development trajectory, while also illustrating the fluctuating and often politically mediated nature of transport investment. Although earlier attempts have quantified infrastructure change, detailed empirical work remains limited (Canning, 1998). The results indicate that historically marginalised regions still lag behind, maintaining sparse and lower-quality road networks despite notable population growth over the past 50 years. Meanwhile, rapidly expanding urban centres, most notably Nairobi, face infrastructure pressure driven not by neglect, but by demographic growth that outpaces road expansion. Given the central role of transport infrastructure in achieving national development goals and the Sustainable Development Goals, it is crucial to identify these persistent disparities. A clearer understanding of where and why these disparities persist can support more equitable planning, guide future investments, and contribute to more balanced and inclusive development across Kenya.

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