From Isolation to Access: Impacts of Rural Road Rehabilitation on Market Accessibility and Mobility in Nyimba and Chibombo Districts, Zambia

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ABSTRACT

Rural roads are widely recognised as a foundation for inclusive rural development, yet evidence on how rehabilitation shapes everyday mobility and market accessibility at the district level remains limited. This paper examines and compares the intermediate impacts of rural road rehabilitation under the Zambia Improved Rural Connectivity Project regarding market accessibility and mobility for small-scale farmers in two contrasting districts, Nyimba and Chibombo. Using a convergent parallel mixed-methods design, this comparative study combines survey data from 372 households located along rehabilitated feeder roads with focus group discussions, key informant interviews and basic GIS analysis. It analyses changes in main modes of transport, travel time to the BOMA and markets, frequency and purpose of trips and perceived ease of access to key services. The findings show that feeder road rehabilitation under the Improved Rural Connectivity Project significantly reduced travel times to the BOMA and markets, increased the share of households who are able to reach key destinations within 90 minutes and improved perceived ease of travel for more than 70% of respondents. In Chibombo, mobility is predominantly motorised, while in Nyimba, intermediate means of transport such as bicycles and motorcycles remain central alongside walking. Across both districts, improved roads have enabled more frequent trips to markets, health facilities and schools, but benefits are unevenly distributed. Households further from the road corridor, poorer households and some female-headed households continue to face cost and service-related constraints. The paper concludes that rural road rehabilitation is a necessary but not sufficient condition for inclusive mobility, and argues for complementary investments in affordable rural transport services, last-mile links and equity-focused planning.

Keywords: Rural roads; Market accessibility; Rural mobility; Small-scale farmers; Zambia.

INTRODUCTION

Background and Motivation

Rural transport infrastructure is widely recognized as a key component of economic development and poverty reduction in low- and middle-income countries such as Zambia. In many agrarian economies, rural roads provide the basic physical link through which people, goods and services move between dispersed settlements and market centres. Where these networks are poorly developed, households face high transport costs, long travel times and in many cases, seasonal isolation during the rainy season (Savić, 2020; Takada et al., 2021). These constraints limit the ability of rural producers to participate in markets, access social services and integrate into wider regional economies. As a result, investments in rural roads are often promoted not only as civil engineering projects, but as catalysts for agricultural transformation, improved service delivery and inclusive growth. Understanding how such investments reshape everyday mobility and market access is therefore central to contemporary debates on rural development. In Zambia, where a significant proportion of

the population relies on small-scale agriculture for their livelihoods, the state of the rural road network remains a critical determinant of economic outcomes, with infrastructural deficits such as those highlighted by a Rural Accessibility Index of 17% exacerbating transaction costs and constraining market engagement (World Bank, 2017).

Zambia provides a particularly relevant context for examining these dynamics. The country is landlocked, with a predominantly rural population and a large share of households relying on small-scale agriculture for their livelihoods. Despite its considerable agricultural potential, especially in several high-rainfall and fertile "breadbasket" regions, the sector has recorded modest growth and persistently low productivity among small-scale farmers (8NDP, 2022). At the same time, rural poverty and inequality remain high, with many communities experiencing limited access to markets, financial services, extension, health care and education. Weak and seasonally impassable feeder roads are a recurring feature of this landscape, raising the cost and time required for routine trips and constraining both economic and social participation. For these reasons, the improvement of rural transport infrastructure has become a central element of the broader strategies for economic diversification, poverty reduction and rural transformation for Zambia (8NDP, 2022).

Within this national context, the Nyimba and Chibombo districts provide contrasting yet complementary settings for examining the effects of rural road rehabilitation on market accessibility and mobility. Nyimba District, located in Eastern Province, is predominantly rural and has historically been characterised by relatively weak connectivity to major markets, with many feeder roads becoming difficult to use during the rainy season. By contrast, Chibombo District in Central Province occupies a more strategic position along major transport corridors linking rural areas to Lusaka and other urban centres, although substantial sections of its rural road network have also suffered from neglect and seasonal disruption. Both districts were selected as beneficiaries of the Improved Rural Connectivity Project, a national initiative designed to rehabilitate and maintain primary feeder roads in key agricultural areas. Under the Improved Rural Connectivity Project, a total of 391 km (175.6 km in Nyimba and 215.4 km in Chibombo) of rural roads in were upgraded to improve all-season passability and to reduce travel times between farming communities and administrative, commercial and service centres. Taken together, these two districts offer a valuable opportunity to compare how similar road interventions play out in areas with different baseline levels of connectivity and spatial integration.

Market accessibility and everyday mobility lie at the heart of these policy ambitions. In practical terms, market accessibility refers to the ability of farmers to reach input and output markets within a reasonable time and at an affordable cost, enabling them to purchase seed and fertiliser, sell farm products before they deteriorate and respond to changing price signals. Well-maintained rural road networks also underpin access to education, healthcare and employment opportunities, as they determine how easily people can travel between dispersed settlements and service centres. In the Zambian context, poor feeder roads have led to long, unreliable journeys by bicycle and ox-cart, with farmers often taking several hours to reach the nearest BOMA or local market and suffering post-harvest losses and missed market opportunities as a result. Beyond strictly economic trips, mobility shapes the frequency with which children attend school, patients visit clinics and households participate in wider social and civic life, all of which influence long-term livelihood trajectories and welfare outcomes. It follows that improvements in rural roads, by reducing travel time and increasing the reliability of movement, have the potential to transform both the economic and social dimensions of rural livelihoods, even though the extent of these gains may vary across places and population groups.

Knowledge Gap

Despite this recognised importance of rural roads, the empirical evidence base remains uneven. A growing body of global research shows that rural road rehabilitation can enhance market accessibility, reduce transport and input costs, and promote agricultural growth and commercialisation (Zhang & Wu, 2022; Lee et al., 2022; Bell, 2022). Studies from Ethiopia, Kenya, and other African countries similarly associate improved feeder roads with higher agricultural incomes, reduced transport costs, and more frequent market trips, reinforcing the idea that transport infrastructure can be a powerful lever for rural transformation (Njenga & Opiyo, 2021). However, there is still limited systematic evidence on these dynamics in Zambia, where rural road networks remain underdeveloped, especially in high-potential "breadbasket" regions such as the Eastern and Central Provinces, where many feeder roads are unusable during the rainy season or have been reduced to pedestrian

tracks (Tamene, 2019). Existing Zambian studies mainly focus on national or provincial trends in production and poverty, which show that agricultural output grew by only about 0.4% per year between 2011 and 2020, compared with population growth of 2.8%, and that rural poverty remains significantly higher than urban poverty (Chapoto et al., 2019; 8NDP, 2022; LCMS, 2022). Yet there is a notable shortage of localised, comparative analyses that trace how rehabilitated rural roads shape market access and mobility across different agro-ecological zones and levels of prior connectivity, particularly in districts such as Nyimba and Chibombo where road rehabilitation has taken place alongside persistent infrastructural gaps and high agricultural potential (IRCP, 2023). Moreover, the perspectives and lived experiences of small-scale farmers in these post-rehabilitation settings have been largely overlooked, despite their importance for understanding how infrastructure improvements translate into tangible livelihood benefits (Agholor et al., 2023). This combination of infrastructure ambition, enduring rural poverty and limited district-level evidence underscores the need for careful empirical work on the intermediate impacts of rehabilitated roads on market accessibility and mobility in Zambia.

Aim, Research Questions and Frameworks

Against this backdrop, this paper aims to assess how rural road rehabilitation under the Improved Rural Connectivity Project has altered market accessibility and everyday mobility for small-scale farmers in Nyimba and Chibombo districts. Specifically, the analysis focuses on changes in travel time, mode of transport, trip frequency and purpose, and perceived ease of access to markets and key services following road rehabilitation. To this end, the paper is guided by the following research question: *How has rural road rehabilitation affected market accessibility and mobility for small-scale farmers in Nyimba and Chibombo districts, and how do these effects vary across space and social groups?* In addressing this question, the paper further asks: (i) how changes in travel time, mode choice and trip frequency differ between Nyimba and Chibombo; (ii) how accessibility outcomes vary with distance from the rehabilitated road; and (iii) how farmers perceive and narrate these changes in their daily lives. The analysis is framed by the Spatial Development Theory, which emphasises the role of infrastructure in reshaping core-periphery relations and regional development trajectories, and by the Sustainable Livelihoods Framework, which conceptualises roads as a form of physical capital that interacts with human, social and financial assets to shape livelihood opportunities. Together, these frameworks provide a lens for interpreting not only whether accessibility has improved, but also for whom, where and with what implications for rural inclusion and inequality.

By pursuing these questions, the paper makes three main contributions. Empirically, it provides district-level, mixed-methods evidence on the intermediate effects of rural road rehabilitation on market accessibility and mobility in Zambia, drawing on a comparative design that contrasts a historically more peripheral district with one that was already partially integrated. Conceptually, it demonstrates the value of combining Spatial Development Theory and the Sustainable Livelihoods Framework to interpret how changes in physical infrastructure translate into differentiated mobility outcomes across space and social groups. Policy-wise, the analysis offers insights for the design of rural road programmes that move beyond counting kilometres rehabilitated towards a stronger focus on who is able to travel, how often and for what purposes. The remainder of the paper is structured as follows: the next section reviews the literature on rural roads, accessibility and livelihoods; the methodology is then outlined; this is followed by the presentation and discussion of the findings; and the paper concludes with key implications for policy and future research.

LITERATURE REVIEW

Global Context and Importance of Rural Roads

Rural road rehabilitation has increasingly been recognised as a pivotal intervention in efforts to stimulate rural economic development and reduce poverty. Empirical studies from diverse developing regions show that upgrading farm-to-market roads enhances connectivity, reduces travel time and transport costs and improves the reliability of movement between rural settlements and trade centres (Isah & Ibrahim, 2024; Takada et al., 2021; Bonsu et al., 2025). These improvements, in turn, are associated with greater use of fertilisers and hybrid seeds, higher crop yields and expanded participation in output markets, as farmers are better able to deliver farm produce on time and to a wider range of buyers. Global empirical research further indicates that road

rehabilitation can enhance market accessibility, lower input costs and promote agricultural intensification by facilitating more frequent visits to markets and closer integration into value chains (Zhang & Wu, 2022; Lee et al., 2022; Bell, 2022). Collectively, this literature frames rural roads not simply as physical assets, but as mechanisms that shape the transaction costs for farmers, spatial reach and capacity to engage with both input and output markets.

Rural Development and Agriculture Context in Zambia

Within Sub-Saharan Africa, a growing body of work links rural transport investments to improved agricultural incomes, market participation and service utilisation. Studies from Ethiopia, Kenya, Malawi and Nigeria document that rehabilitated rural roads can raise farm incomes, increase the volume of produce reaching markets and reduce farm-gate price distortions by lowering transport costs and encouraging more frequent market trips (Njenga & Opiyo, 2021; Nura, 2022; Olagunju, 2022). In Zambia, similar research suggests that areas with better rural road infrastructure have higher volumes of agricultural products reaching markets during harvest seasons and improved smallholder participation in commercial channels. However, the rural road network remains significantly underdeveloped, particularly in high-potential "breadbasket" regions such as the Eastern and Central Provinces, where numerous feeder roads are either unusable during the rainy season or have been degraded into pedestrian pathways (Tamene, 2019). These conditions elevate transaction costs, restrict the mobility of small-scale farmers and contribute to persistent rural poverty, despite the considerable agricultural potential of the country.

Beyond broad correlations between road quality and economic outcomes, recent work has unpacked the specific mechanisms through which rural roads affect market access and mobility. Improved road surfaces and drainage reduce travel time and the risk of impassable sections, thereby lowering the "friction of distance" and enabling more frequent and flexible trips to markets, aggregation points and administrative centres (Friedmann, 1966; Parr, 2002). These changes, in turn, influence the choice of transport mode for farmers, the timing of journeys and their willingness to engage in perishable or high-value value chains. Studies grounded in the Sustainable Livelihoods Framework argue that enhanced accessibility expands physical capital and can trigger sequential gains in financial, human and social capital as households use improved mobility to access markets, services and networks more effectively (Scoones, 1998; Ellis, 2000). In Zambia, evidence from rural districts such as Nyimba and Chibombo suggests that rehabilitated roads have substantially reduced long-duration travel to the BOMA and increased satisfaction with travel time, but that the depth of these benefits is mediated by distance from the road, pre-existing asset bases and the availability of affordable transport services (IRCP, 2023). This literature offers a detailed view of market accessibility and mobility, suggesting that roads can transform the geography of opportunity, but actual outcomes depend on how infrastructure interacts with spatial structure and household-level constraints, issues central to the comparative experience of Nyimba and Chibombo under the Improved Rural Connectivity Project.

Spatial Development Theory and the Sustainable Livelihoods Framework

Building on these empirical insights, recent scholarship has increasingly turned to spatial and livelihoods-oriented theories to interpret how infrastructure reshapes rural opportunity structures. Spatial Development Theory emphasises the role of transport corridors, growth poles and core-periphery relations in structuring the distribution of economic activity across regions, arguing that improved connectivity can both reduce spatial peripherality and, in some cases, reinforce new forms of uneven development (Friedmann, 1966; Parr, 2002; World Bank, 2009). In parallel, the Sustainable Livelihoods Framework conceptualises roads as part of the physical capital that interacts with human, social, natural and financial capital to shape the capabilities of household strategies and outcomes (Scoones, 1998; Ellis, 2000). Together, these perspectives highlight that the impacts of rural road rehabilitation on market access and mobility are mediated by spatial location, institutional context and the asset portfolios of different social groups. In districts such as Nyimba and Chibombo, where rehabilitated corridors traverse heterogeneous settlements and livelihood systems, Spatial Development Theory draws attention to how improved roads integrate previously marginalised zones into regional networks, while the Sustainable Livelihoods Framework underscores how the ability of households to translate new physical connectivity into concrete mobility gains depends on their resources, social networks and vulnerability context. This combined lens suggests that analysing road rehabilitation solely in terms of

physical improvements risks overlooking the differentiated accessibility outcomes that emerge within and between districts.

RESEARCH METHODOLOGY

This study employed a mixed-methods research methodology to examine how rural road rehabilitation has affected market accessibility and everyday mobility among small-scale farmers in Nyimba and Chibombo districts. Anchored in the Spatial Development Theory and Sustainable Livelihoods Framework, the methodology was designed to capture both the spatial-economic transformations associated with improved transport infrastructure and the livelihood-level consequences experienced by rural households. A concurrent mixed-methods design was adopted, integrating quantitative household surveys with qualitative interviews and focus group discussions. Quantitative techniques were used to evaluate measurable changes in travel time, mode of transport and frequency of trips to markets and key services, while qualitative methods explored the perceptions of farmers, narratives and lived experiences of changing accessibility. This combination of methods enabled a comprehensive understanding of how road rehabilitation interventions work in practice, and how physical improvements in infrastructure translate into patterns of mobility and market access across different social and spatial contexts.

Research Design and Paradigm

The research was guided by a pragmatic paradigm, which prioritises methodological choices that are most effective for addressing the research questions rather than adherence to a single philosophical tradition. Within this paradigm, a concurrent mixed-methods design embedded within a predominantly quantitative framework was selected, with qualitative data used to enrich and explain quantitative patterns. A comparative case study strategy focusing on Nyimba and Chibombo districts provided the overall research design. Consistent with Yin's (2018) conception of case studies, this strategy allowed for an in-depth exploration of the specific contexts in which rural road rehabilitation occurred and facilitated detailed examination of how similar infrastructure interventions produced differentiated accessibility outcomes in two distinct spatial settings. The comparative lens is also aligned with the Spatial Development Theory's emphasis on spatial disparities and the Sustainable Livelihoods Framework's focus on heterogeneous livelihood strategies, making the design well-suited to analysing variation in market access and mobility across districts and social groups.

Study Area Description – Nyimba and Chibombo

The empirical work was conducted in Nyimba District in Eastern Province and Chibombo District in Central Province, two areas selected for their contrasting yet complementary characteristics in terms of agricultural production, geographic positioning and infrastructural development. Nyimba lies approximately 350 kilometres east of Lusaka along the Great East Road, within agro-ecological Region II, and is characterised by moderate rainfall and relatively fertile soils that support the production of maize, groundnuts, sunflowers and cotton. Despite this potential, Nyimba has historically faced market isolation due to limited rural transport infrastructure and poor feeder roads, which restrict farmers' access to input and output markets, especially in more remote parts of the district. Chibombo, by contrast, is strategically located between Lusaka and Kabwe, with closer proximity to major urban centres and transport corridors and a more diversified agricultural system that includes maize, groundnuts, beans and horticultural crops alongside emerging medium-scale farmers. However, intra-district disparities in transport infrastructure mean that many rural communities in Chibombo also experience poor access to markets and services. The selection of these two districts therefore provided an opportunity to examine how rural road rehabilitation under the Improved Rural Connectivity Project influenced market accessibility and mobility in both a relatively peripheral and a more spatially advantaged setting.

Quantitative Sampling Procedure

For the quantitative component, the target population comprised small-scale farming households residing in communities served by the rehabilitated primary feeder roads in Nyimba and Chibombo. The sampling frame was constructed using Enumeration Areas delineated by the Zambia Statistics Agency, focusing on those

intersected by, or lying in close proximity to, the Improved Rural Connectivity Project road corridors. A multi-stage sampling strategy was employed. In the first stage, Enumeration Areas were stratified by district and by distance bands from the rehabilitated road to ensure coverage of households located at varying levels of physical proximity. A sample of Enumeration Areas was then randomly selected from each stratum. In the second stage, households within the selected Enumeration Areas were listed and a fixed number of small-scale farming households were randomly drawn from each Enumeration Area using simple random sampling procedures. This approach yielded a total survey sample of 372 households, distributed across Nyimba and Chibombo, and ensured that the data captured variation in market accessibility and mobility both within and between districts while maintaining statistical representativeness at the corridor level.

Qualitative Sampling Procedure

The qualitative component used purposive and snowball sampling techniques to select information-rich participants who could provide detailed insights into changing accessibility and mobility conditions. Within each district, focus group discussions were organised with small-scale farmers from different distance bands along the rehabilitated road, with attention to diversity in gender, age and socio-economic status so as to capture a range of lived experiences. Participants for these groups were identified with the assistance of local leaders and supplemented through referrals from initial participants. In addition, key informant interviews were conducted with actors who occupy strategic positions in the local transport and market systems, including council officials, representatives of Contracting Entities, agro-input dealers, transport service providers and community leaders. These informants were selected purposively on the basis of their knowledge of road conditions, transport services and market dynamics, and, where necessary, additional interviewees were identified through snowballing. This sampling strategy complemented the household survey by providing contextual and explanatory perspectives on the quantitative patterns observed.

Quantitative Data Collection

Quantitative data were collected using a structured household questionnaire administered to the sampled small-scale farming households in Nyimba and Chibombo. The instrument captured information on demographic characteristics, livelihood activities and, most importantly for this paper, indicators of market accessibility and mobility. These included self-reported distance and travel time to the nearest BOMA and main market, primary modes of transport used before and after road rehabilitation, frequency and purpose of trips to markets and key services, and the perceptions of respondents regarding ease of travel over time. To minimise recall bias when eliciting “before” conditions, enumerators anchored questions to clearly defined reference periods corresponding to the pre-rehabilitation phase of the Improved Rural Connectivity Project and used probing techniques to help respondents relate travel experiences to specific seasons and events. The questionnaire was pre-tested in non-sampled communities with similar characteristics, and minor revisions were made to clarify wording and sequencing before full implementation.

Qualitative and Spatial Data Collection

Qualitative data were gathered through focus group discussions and key informant interviews in both districts. Focus groups with small-scale farmers were guided by semi-structured discussion prompts that explored participants’ experiences of travelling to markets and service centres before and after road rehabilitation, perceived changes in transport options and costs, and views on who had benefited most or least from the improved roads. Key informant interviews followed tailored guides that addressed road planning and maintenance, transport service provision and observed changes in market activity along the rehabilitated corridors. All discussions and interviews were conducted in locally appropriate languages, audio-recorded with permission and supplemented by detailed field notes. In addition, spatial data on the location of rehabilitated roads, settlements and BOMA centres were compiled using existing maps and Geographic Information Systems readings collected in the field. These data were subsequently used within a Geographic Information Systems environment to validate and, where possible, refine distance estimates between communities and key service points.

Variables and Data Analysis

The analysis focused on a set of core variables capturing different dimensions of accessibility and mobility. Key outcome variables included the main mode of transport used to reach the BOMA or principal market, reported travel time to these destinations, frequency of trips within a specified period and perceived ease of travel measured on an ordinal scale. These were examined alongside contextual variables such as district, distance band from the rehabilitated road, gender of household head, household size and selected indicators of asset ownership. Quantitative data were entered, cleaned and analysed using standard statistical software. Descriptive statistics were used to summarise accessibility indicators before and after road rehabilitation, while cross-tabulations and simple comparative tests were employed to explore differences between districts, distance bands and selected socio-economic categories. Qualitative data were transcribed and subjected to thematic analysis, with codes and themes developed around perceptions of change in accessibility, emerging opportunities and remaining constraints. Findings from the qualitative analysis were then integrated with the quantitative results to provide explanations and nuance for the observed patterns, consistent with the concurrent mixed-methods design.

Ethical Considerations and Limitations

The study adhered to established ethical standards for social research. Ethical clearance was obtained from the University of Lusaka Ethics Committee and permissions were sought from district authorities and community leaders before fieldwork commenced. All participants were informed about the purpose of the study, the voluntary nature of their participation, their right to withdraw at any time and the measures taken to ensure confidentiality and anonymity. Informed consent was obtained verbally or in writing, depending on local norms and literacy levels. The raw data are available for verification or further analysis. The author declares that there are no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

While the mixed-methods design and comparative case study approach strengthened the validity of the findings, several methodological limitations should be acknowledged. First, the reliance on respondent recall for conditions prior to road rehabilitation introduces potential recall bias, despite efforts to anchor questions to specific periods and events. Second, the analysis captures intermediate rather than long-term impacts, as data were collected relatively soon after completion of the rehabilitation works. Third, the focus on two districts limits the generalisability of the results to other contexts, although the contrasting characteristics of Nyimba and Chibombo enhance the broader relevance of the insights generated.

FINDINGS AND DISCUSSION

Overview of Changes in Market Accessibility and Mobility

Market accessibility was the most immediate and tangible domain in which the effects of rural road rehabilitation became visible. Consistent with the research question, this section examines how the ability to reach markets and administrative centres of small-scale farmers changed following the Improved Rural Connectivity Project interventions in Nyimba and Chibombo. For small-scale producers, accessibility shapes the extent to which they can acquire inputs, transport farm products, interact with traders and engage with social and economic institutions. Within the Spatial Development Theory framework, improved accessibility reflects a reduction in spatial frictions and a closer functional integration of peripheral rural communities into regional economic systems. Within the Sustainable Livelihoods Framework, it represents a strengthening of physical capital that enables households to mobilise and combine other livelihood assets more effectively.

The survey results indicate that rural road rehabilitation substantially improved market accessibility in both study districts, albeit in ways that varied by location and social group. Overall, respondents reported easier travel to the BOMA and main markets, reductions in the time required to complete trips, and greater ease in reaching key services such as health facilities and schools. Across Nyimba and Chibombo, more than 70 percent of households indicated that travel to essential social and economic services had become “much easier” or “somewhat easier,” a pattern that aligns with the Spatial Development Theory argument that

improved connectivity lowers transaction and opportunity costs. Qualitative narratives corroborate this shift, with farmers emphasising that journeys which previously took most of the day, particularly during the rainy season, can now be completed more quickly and reliably, often allowing same-day trips for trade, clinic visits and administrative errands.

At the same time, the findings reveal that these gains are unevenly distributed. Chibombo, which already enjoyed relatively stronger integration into the national transport network via the Great North Road, shows a more pronounced reliance on motorised transport and higher levels of satisfaction with travel time among households located close to the rehabilitated roads. Nyimba, historically more peripheral, experienced substantial improvements in travel time and frequency of trips, but continues to exhibit greater dependence on motorcycles and bicycles and a higher degree of uncertainty regarding the reliability of transport services, particularly among households within 2 km of the road who were unsure whether travel time had improved. From a Sustainable Livelihoods Framework perspective, these patterns suggest that while physical connectivity has improved, households with limited financial capital and weaker institutional linkages may still struggle to convert potential accessibility into realised mobility.

The remainder of this section unpacks these dynamics in greater detail. The following immediate section examines how the main modes of transport to the BOMA have shifted in response to road rehabilitation, highlighting differences between and within the two districts. This is followed by a section analysing changes in travel time distributions before and after rehabilitation; then perceived ease of travel and levels of satisfaction with access are considered thereafter. Subsequently, an exploration of changes in the frequency and purpose of trips to markets and key services is covered. The last but not least section interrogates spatial and social differentiation in these accessibility gains by distance from the road and household characteristics. Finally, a synthesis of the findings through the lenses of Spatial Development Theory and Sustainable Livelihoods Framework, drawing out the implications for how rural road interventions shape the geography of opportunity and patterns of inclusion for small-scale farmers in Nyimba and Chibombo is highlighted.

Main mode of transport to the BOMA

Patterns in the main mode of transport to the BOMA provide a first, concrete indication of how rural road rehabilitation has reshaped everyday mobility. For small-scale farmers, the ability to reach the district centre by different modes (on foot, by bicycle or motorcycle, or using motor vehicles) strongly conditions how often they can travel, what volumes of produce they can carry and how they engage with state and market institutions. Within the Spatial Development Theory lens, shifts in dominant modes of transport signal changes in how communities are functionally integrated into regional transport economies, while from a Sustainable Livelihoods Framework perspective they reflect how improvements in physical capital interact with financial and social assets to enable or constrain mobility.

In Chibombo, the data show a transport system that is overwhelmingly motorised (Table 1). Among households living within 2 km of the rehabilitated road, 91.0% reported using motor vehicles as their main means of reaching the BOMA, compared with only 2.6% who primarily walked and 6.4% who relied on motorcycles. Even among households located more than 2 km from the corridor, motor vehicles remained dominant, used by 78.7% of respondents, while 9.3% walked, 8.3% cycled and 3.7% used motorcycles. Overall, 83.9% of surveyed households in Chibombo relied on motor vehicles as their primary mode of transport to the BOMA. This pattern reflects not only the improved condition of the rehabilitated feeder roads but also the pre-existing integration of the district into the Great North Road corridor and its relatively dense network of commercial transport services. In Spatial Development Theory terms, Chibombo appears as a semi-core space where road rehabilitation mainly reinforces and deepens already established vehicular connectivity.

Table 1: Mode of Transport Mainly Used to Travel to the BOMA

District	Distance	N	Footing (%)	Motor vehicle (%)	Motor-cycle (%)	Bicycle (%)
Chibombo	Within 2km	78	2.6	91.0	6.4	0.0
	Beyond 2km	108	9.3	78.7	3.7	8.3
	Total	186	6.5	83.9	4.8	4.8
Nyimba	Within 2km	164	33.5	8.5	35.4	22.6
	Beyond 2km	22	18.2	13.6	31.8	36.4
	Total	186	31.7	9.1	34.9	24.2
Total	Within 2km	242	23.6	35.1	26.0	15.3
	Beyond 2km	130	10.8	67.7	8.5	13.1
	Total	372	19.1	46.5	19.9	14.5

By contrast, Nyimba exhibits a much more diverse modal profile, with a strong presence of intermediate and non-motorised transport. Among households within 2 km of the rehabilitated road, 35.4% reported motorcycles as their main means of reaching the BOMA, 33.5% travelled on foot and 22.6% used bicycles, while only 8.5% relied on motor vehicles. For households situated beyond 2 km, dependence on bicycles increased further to 36.4%, motorcycles remained substantial at 31.8% and motor vehicles were used by 13.6% of respondents. Aggregated across distance bands, just 9.1% of Nyimba respondents reported motor vehicles as their main transport mode, compared with 34.9% using motorcycles and 24.2% using bicycles, and almost one-third (31.7%) still walking. This modal mix points to significant improvements in mobility options, especially through motorcycles and bicycles, but also to continuing gaps in access to formal motor vehicle services.

Taken together, the cross-district comparison highlights marked spatial differentiation in transport systems along the rehabilitated corridors. When both districts and distance bands are combined, 46.5% of all surveyed households reported motor vehicles as their primary mode of reaching the BOMA, 19.9% used motorcycles, 14.5% bicycles and 19.1% walked. Yet this aggregate masks the stark contrast between a highly motorised Chibombo corridor and a Nyimba setting where intermediate means of transport remain central to everyday mobility. Distance from the rehabilitated road also matters: across both districts, households located further than 2 km from the corridor are less likely to rely on motor vehicles and more likely to depend on walking or bicycles, indicating that the benefits of improved road surfaces attenuate with spatial separation from the main alignment.

Qualitative narratives from the field help explain these patterns. In Chibombo, several respondents emphasised continuity rather than transformation in their transport behaviour: as one farmer noted, *"We already used vehicles, but now the road is smoother. It's easier to reach the depot without damaging the truck."* This suggests that road rehabilitation in a relatively well-served corridor primarily improved comfort, speed and reliability for existing vehicle users rather than inducing a major modal shift. In Nyimba, by contrast, participants described more dramatic changes. A young farmer reported that he previously borrowed an ox-cart but was now able to purchase a small motorcycle through a cooperative loan, enabling faster and more flexible trips and larger volumes of goods carried to market. At the same time, other respondents, particularly from more remote villages, stressed that they still walked due to lack of bicycles, motorcycles or the means to pay for vehicle transport: *"The road is good now, but we still walk. We don't have bicycles or motorbikes. If someone gives us a lift, we are lucky."*

These findings underscore that while improved road conditions are a necessary precondition for expanding mobility options, they are not sufficient to ensure equitable access to higher-capacity modes. From a Spatial Development Theory perspective, the proximity of Chibombo to the Great North Road and denser settlement along major corridors facilitates deeper penetration of motorised transport services, reinforcing its position within regional growth networks. In Nyimba, settlement dispersion, lower income levels and weaker institutional linkages mean that households are more reliant on intermediate modes, even after physical rehabilitation, and that the spatial benefits of improved corridors are more unevenly distributed. Within the Sustainable Livelihoods Framework, this modal differentiation illustrates how enhanced physical capital (better roads) only translates into improved mobility where households also possess sufficient financial capital, access to credit or cooperative support, and social networks to obtain and operate vehicles. Households lacking these assets remain largely confined to low-speed, low-capacity modes, despite living along or near rehabilitated roads.

Changes in Travel Time to the BOMA

Travel time to the district administrative centre (BOMA) offers one of the clearest and most intuitive indicators of changing physical accessibility following rural road rehabilitation. Under Spatial Development Theory, reductions in travel time represent a concrete expression of "time-space compression," whereby improved connectivity narrows the effective distance between peripheral communities and regional centres of administration and commerce. Within the Sustainable Livelihoods Framework, shorter and more predictable journeys are interpreted as an enhancement of physical capital that enables households to access markets, services and social networks more efficiently, thereby supporting livelihood diversification and resilience. Against this conceptual backdrop, the impact of the Improved Rural Connectivity Project on travel time to the BOMA in Nyimba and Chibombo provides an important lens through which to assess changes in market accessibility and everyday mobility.

The survey data reveal substantial reductions in travel time in both districts, with particularly large shifts away from very long journeys. In Chibombo, prior to rehabilitation 39.2% of households reported journey times of more than 150 minutes to reach the BOMA and a further 28.5% took between 120 and 150 minutes, meaning that more than two-thirds of households faced trips exceeding two hours (Table 2). After road rehabilitation, the share travelling more than 150 minutes fell to 22.0%, and those in the 120 - 150 minute category dropped sharply to 9.1%. At the same time, the proportion of households reaching the BOMA in less than 90 minutes increased from 16.2% before to 43.1% after rehabilitation, indicating a marked shift in the travel-time distribution towards shorter journeys. These figures support the broader summary that the share of Chibombo households travelling under 90 minutes rose from 16.2% to 55.9% once market trips are also considered.

Table 2: Distribution of Respondents by Time Taken to Reach the BOMA Before and After Rehabilitation

District	Time taken (min)	Before (%)	After (%)
Chibombo	Less than 30	2.7	10.8
	30 - 60	3.8	12.9
	60 - 90	9.7	19.4
	90 - 120	16.1	25.8
	120 - 150	28.5	9.1
	More than 150	39.2	22.0
	Total	100.0	100.0

Nyimba	Less than 30	0.5	1.6
	30 - 60	5.9	14.5
	60 - 90	15.1	26.3
	90 - 120	16.1	25.3
	120 - 150	18.8	11.8
	More than 150	43.5	20.4
	Total	100.0	100.0

Nyimba exhibits a similar pattern of improvement, albeit from a more disadvantageous starting point and with a somewhat more gradual transition. Before rehabilitation, 43.5% of Nyimba households needed more than 150 minutes to reach the BOMA and 18.8% fell in the 120 - 150 minute band, again implying that the majority required in excess of two hours per trip. Following the Improved Rural Connectivity Project works, the share of households travelling more than 150 minutes decreased to 20.4%, and those taking 120 - 150 minutes declined to 11.8%. At the other end of the distribution, the proportion reaching the BOMA in under 60 minutes more than doubled from 6.4% to 16.1%, and those taking 60 - 90 minutes increased from 15.1% to 26.3%, while the 90 - 120 minute group rose from 16.1% to 25.3%. When framed more broadly, the data show that the share of Nyimba households travelling less than 90 minutes to the BOMA or market increased from 21.5% to 68.2%, a dramatic improvement for a district historically marked by dispersed settlements and poor feeder roads.

These shifts point to several important interpretive trends. First, long-duration travel burdens greater than 120 minutes, which previously dominated in both districts, have effectively halved, consistent with the Spatial Development Theory argument that infrastructure investment reduces peripherality and shortens economic distance between rural settlements and central service hubs. Second, while Chibombo continues to enjoy shorter travel times on average, the gap between the two districts has narrowed, suggesting a partial spatial equalisation in access to administrative centres. This convergence aligns with the notion of "spatial diffusion" of growth-pole effects along rehabilitated corridors, as improved feeder roads extend the functional reach of existing trunk networks into previously under-served hinterlands. Third, shorter travel times expand what might be termed "daily mobility potential": households can now complete same-day trips for trading, administrative errands and service access, which in turn deepens their human and social capital.

Voices from the communities vividly illustrate these quantitative patterns. A male farmer in Chibombo recalled that before the road works, *"Reaching the BOMA was a full-day affair; now we can go and return before sunset..."* underscoring how reduced travel time restructures the daily rhythm of economic and social life. In Nyimba, an elderly farmer noted that, *"...now even ox-carts can reach the BOMA after rains; before, we waited weeks..."* signalling not only faster journeys but also a longer season of physical access when roads remain passable during periods that previously brought movement to a halt. Traders in Chibombo similarly highlighted that, *"...bus fares have reduced because more vehicles are coming; we travel anytime..."* pointing to the way travel-time reductions interact with increased service frequency and competition. From a Sustainable Livelihoods Framework perspective, these testimonies show how improved physical capital catalyses expansions in financial capital (through more frequent sales and purchases), human capital (through greater access to clinics and schools) and social capital (through intensified rural-urban linkages).

At the same time, the analysis and narratives caution against assuming uniform benefits. The dissertation estimates that Improved Rural Connectivity Project interventions led to an overall 40 - 50% reduction in average travel time to administrative centres across both districts, confirming that rehabilitated rural roads directly enhance spatial accessibility and align with Spatial Development Theory's diffusion of growth-pole effects. Yet, as the Sustainable Livelihoods Framework emphasises and as subsequent subsections

demonstrate, the advantages of shorter journeys are unevenly realised, depending on households' transport means, education, income and social networks. In this sense, reduced travel time opens a "window of opportunity," but turning that opportunity into improved livelihoods requires complementary interventions in transport services, market development and inclusive support mechanisms, particularly for more remote and resource-poor households.

Perceived Ease of Travel and Satisfaction with Access

Perceived ease of travel to key destinations provides an important complement to the "hard" indicators of mode choice and travel time. Table 3 shows that road rehabilitation was widely experienced as a reduction in travel difficulty in both districts. In Chibombo, 44.1% of respondents reported that travel to important places such as schools, health centres and local markets was now "much easier," and a further 30.6% said it was "somewhat easier." In Nyimba, 38.7% stated that travel was "much easier" and 36.0% "somewhat easier." Across both districts, more than 70% of respondents thus perceived some degree of improvement, while around one-fifth in each district reported "no change," and only a small minority felt that travel had become more difficult. These perceptions align with the Spatial Development Theory expectation that improved connectivity lowers the friction of distance and with the Sustainable Livelihoods Framework emphasis on enhanced physical capital facilitating access to services.

Table 3: Distribution of Respondents by Ease of Access to Important Places

District		Frequency	Percent
Chibombo	Yes, travel is now much easier	82	44.1
	Yes, travel is somewhat easier	57	30.6
	No change	41	22.0
	Travel is more difficult now	6	3.2
	Total	186	100.0
Nyimba	Yes, travel is now much easier	72	38.7
	Yes, travel is somewhat easier	67	36.0
	No change	39	21.0
	Travel is more difficult now	8	4.3
	Total	186	100.0

Qualitative accounts reinforce these quantitative patterns and reveal how perceived ease links to concrete experiences. A female respondent from Chibombo commented*, "Before, we could not reach the clinic when it rained; now ambulances come right to the village in case of emergencies."* underscoring how all-weather access changes the stakes of mobility for health and survival. At the same time, roughly 21-22% of respondents in each district reported no change in ease of travel. This group is likely to include households located off the main rehabilitated corridor or in areas where smaller feeder links, bridges and culverts remain weak, illustrating that spatial barriers can persist even when primary roads are upgraded. A few respondents indicated that travel was now more difficult, pointing to increased traffic, dust and higher fares as offsetting factors that accompany road improvements. From the perspective of the Author, these findings support the argument that accessibility is multidimensional: while spatial barriers have fallen, economic and service-quality barriers continue to shape how "easy" travel actually feels.

Perceptions of ease are echoed in reported satisfaction with the time taken to reach the BOMA after road rehabilitation (Table 4). In Chibombo, 66.7% of households within 2 km of the road reported being satisfied with the time to reach the BOMA, compared with 46.3% among those living further than 2 km, a gap of about 20 percentage points. In Nyimba, satisfaction was slightly lower but more spatially even, with 48.8% of households within 2 km and 45.5% beyond 2 km reporting satisfaction. Notably, however, 32.3% of Nyimba households within 2 km responded "I don't know" when asked about satisfaction with travel time, compared to only 1.3% in Chibombo. The report interprets this ambivalence as an indication that in Nyimba, where transport services are more irregular and seasonality remains pronounced, reliability rather than speed alone is the key determinant of satisfaction. In Spatial Development Theory terms, time-space compression is more fully realised where networks are dense and service flows are frequent; from an SLF perspective, households value predictability because it underpins planning and livelihood management.

Table 4: Satisfaction with Time to Reach the BOMA After Rehabilitation, by District and Distance

District	Distance to the New Road		Percent
Chibombo	Not more than 2 km	Yes	66.7
		No	32.1
		I don't know	1.3
	More than 2 km	Yes	46.3
		No	46.3
		I don't know	7.4
Nyimba	Not more than 2 km	Yes	48.8
		No	18.9
		I don't know	32.3
	More than 2 km	Yes	45.5
		No	36.4
		I don't know	18.2

The reasons households cited for satisfaction with travel after road rehabilitation further clarify how people experience improved access (Table 5). In Chibombo, among households within 2 km of the road, reduced time of travel (23.1%) and improved accessibility (19.2%) were the main reasons for satisfaction, with additional mentions of comfort and fewer accidents. In Nyimba, reduced time (23.8%) was also the top reason, but safety featured much more prominently: 13.4% of households within 2 km of the road highlighted safety as their primary reason for satisfaction, compared to only 3.8% in Chibombo. A Nyimba resident noted, *"Before, we feared the crossing in the rains; now the ambulance reaches us."* capturing the salience of safe, all-weather access in areas previously punctuated by impassable sections. At the same time, concerns about over-speeding, roadside dust and the proximity of the road to homesteads and schools were widely reported in both districts, highlighting that improved surfaces can introduce new safety and environmental risks alongside benefits.

Table 5: Main Reasons for Household Satisfaction with Travel Post-Rehabilitation, by District and Distance

District	Distance to the New Road		Percent
Chibombo	Not more than 2 km	Safety	3.8
		Accessibility	19.2
		Comfort	9.0
		Reduced accidents	5.1
		Reduced time of travel	23.1
		Maintenance	6.4
		Not Applicable	33.3
	More than 2 km	Safety	10.2
		Accessibility	6.5
		Comfort	2.8
		Reduced accidents	9.3
		Reduced time of travel	13.0
		Maintenance	2.8
		Other(Specify)	1.9
		Not Applicable	53.7
Nyimba	Not more than 2 km	Safety	13.4
		Accessibility	3.0
		Comfort	5.5
		Reduced accidents	1.2
		Reduced time of travel	23.8
		Maintenance	1.8
		Not Applicable	51.2
	More than 2 km	Safety	27.3
		Accessibility	9.1
		Reduced time of travel	9.1
		Not Applicable	54.5

These mixed perceptions strengthen the argument that road projects must be evaluated not only through engineering indicators or average travel times, but through the lens of user satisfaction and perceived quality of access. Under Spatial Development Theory, spatial gains that ignore safety and environmental externalities may ultimately undermine the developmental legitimacy of infrastructure investment. Under the Sustainable Livelihood Framework, satisfaction with access reflects enhanced physical capital, yet remains contingent on financial means to afford transport and on the security of movement, especially for vulnerable groups such as women, children and the elderly. In the context of Nyimba and Chibombo, the findings suggest that while the Improved Rural Connectivity Project has broadly succeeded in restoring mobility rights and improving perceived ease of travel, consolidating these gains will require attention to reliability, affordability and road safety features (such as speed-calming measures, non-motorised shoulders and crossings) that ensure accessibility is both efficient and safe for all users.

Changes in the frequency and purpose of travel

Beyond modes and journey times, changes in how often people move, and for what reasons, offer a crucial indicator of how accessibility is being translated into lived mobility. Table 6 summarises respondents' perceptions of how the rehabilitation of rural roads affected the frequency of travel to key destinations such as markets, health centres, schools and administrative centres (BOMAs). In Chibombo, 38.2% of households reported an increase in travel frequency, 59.7% perceived no change and only 2.2% reported a decrease. In Nyimba, the proportion reporting increased travel frequency was slightly higher at 42.5%, while 52.7% indicated no change and 4.8% reported reduced travel. Taken together, these findings suggest that roughly four in ten households in both districts experienced more frequent trips after rehabilitation, but a majority saw their travel frequency as unchanged, despite improved road conditions.

Table 6: Percentage Distribution of Households by Frequency of Travel

District		Frequency	Percent
Chibombo	Increased travel frequency	71	38.2
	No change in travel frequency	111	59.7
	Decreased travel frequency	4	2.2
Nyimba	Increased travel frequency	79	42.5
	No change in travel frequency	98	52.7
	Decreased travel frequency	9	4.8

The emerging trends point to a nuanced picture of behavioural response. On the one hand, the share of households reporting increased travel frequency is consistent with the Spatial Development Theory proposition that infrastructure investment reduces the friction of distance and intensifies spatial interaction by making trips less costly and more predictable (Friedmann, 1966). Respondents highlighted that previously impassable or risky journeys, particularly during the rainy season, had become viable, allowing more regular engagement with markets, health facilities and administrative offices. A trader in Chibombo captured this shift succinctly, *"We can now go to the market twice a week instead of once a month."* while a village head in Nyimba noted that *"even old people travel more often because buses come closer".* These testimonies underscore the idea that once a minimum threshold of road quality is achieved, mobility behaviour can change quite rapidly as households seize new opportunities for trade and service access.

On the other hand, the finding that more than half of respondents in both districts reported no change in travel frequency indicates that improved roads alone do not automatically translate into more movement. From an SLF perspective, this pattern suggests that while physical capital has been strengthened, many households still

lack the financial or social capital required to take full advantage of the new accessibility. Qualitative evidence reinforces this interpretation. In Chibombo, households close to the road described "modest but meaningful" improvements in their ability to travel, particularly in terms of seasonal reliability, yet those beyond the 2 km radius often felt that the effort and cost of travel remained prohibitive: *"The road is better, but it's still a long way to walk or push a bicycle from our village. Unless we have transport, it feels the same".* A female respondent from Mumbwa added, *"The road is fine now, but if you don't have a bike or money for a lift, you still stay home,"* highlighting the continuing role of fare affordability and asset ownership as key constraints.

The district comparison suggests that Nyimba experienced a somewhat more transformative change in travel behaviour, especially among communities located within 2 km of the upgraded roads. The research notes that Nyimba showed a "slightly more favourable shift" in travel frequency, a dynamic attributed to lower baseline mobility levels, which meant that the marginal impact of rehabilitation was higher. Focus group narratives from Nyimba emphasised the confidence and regularity of travel as much as its frequency: for example, a female trader explained that since the road was graded, she now attends the weekly market twice a week instead of once a month, using the improved surface and more available transport to expand her trading activities. These accounts suggest that in more peripheral settings, where movement was previously heavily constrained, better roads can unlock not only more trips but also new rhythms of participation in economic and social life.

Taken together, the quantitative patterns and qualitative narratives indicate that road rehabilitation has expanded the potential for more frequent travel, but actual behavioural change is conditional. Under Spatial Development Theory, the results are consistent with a "threshold effect," whereby movement intensifies once roads reach basic all-weather standards, particularly in previously marginal areas. Under the Sustainable Livelihood Framework, the coexistence of increased and unchanged mobility points to the importance of convertibility: households with transport assets, access to credit or strong networks are better able to convert improved physical access into higher travel frequency and broader engagement in markets and services, while poorer and more distant households remain constrained. From the perspective of the Researcher, the Improved Rural Connectivity Project has opened a window of mobility opportunities, but fully realising the gains requires complementary interventions, such as affordable rural transport services, targeted support for intermediate means of transport and livelihood linkages, that enable a wider range of households to move more often, and for more productive purposes.

Spatial and Social Differentiation of Accessibility Gains

While the preceding subsections point to clear average improvements in modes of transport, travel time and perceived ease of movement, they also conceal significant variation in who benefits and by how much. A central insight from both Spatial Development Theory and the Sustainable Livelihoods Framework is that the impacts of infrastructure are mediated by location and by asset portfolios of households. The Improved Rural Connectivity Project experience in Nyimba and Chibombo confirms this: improved roads have clearly expanded the potential for mobility, but the gains are spatially and socially differentiated rather than evenly distributed across the rural population.

Spatial differentiation is most visible when travel outcomes are disaggregated by distance from the rehabilitated road. Households located within a short walking distance of the corridor (for instance, within roughly 2 km) report the greatest improvements in travel time, the strongest shift towards motorised or intermediate modes, and the highest satisfaction with access to the BOMA and key services. For these households, the rehabilitated road functions as an easily accessible spine, enabling frequent travel and providing ready contact with transport services such as minibuses, taxis and motorcycles. By contrast, households located further away from the road often still face long journeys on foot or by bicycle just to reach the corridor, after which additional time and cost are required to complete trips to markets or administrative centres. For them, the effective door-to-door travel burden remains substantial, and in some cases they report little or no change in how often they travel, despite recognising that the road surface itself has improved.

Within each distance band, socio-economic status further stratifies the degree of benefit derived from road rehabilitation. Households with greater financial capital, those owning livestock, intermediate means of

transport such as bicycles or motorcycles, or small non-farm enterprises, are better positioned to capitalise on the new infrastructure. They can afford fares, invest in their own transport, or leverage social networks to access vehicles, thereby translating improved road conditions into concrete mobility gains and expanded livelihood opportunities. Poorer households, by contrast, frequently describe continued reliance on walking and limited ability to travel more often, even when they acknowledge that the road is smoother and passable year-round. In Nyimba in particular, some respondents living along the upgraded corridor still emphasised their lack of bicycles or motor cycles as a key constraint: the road now allows vehicles to pass, but they do not yet have the means to use those vehicles regularly.

Gender and other social factors add another layer of differentiation. In both districts, women often shoulder a disproportionate share of household and care responsibilities, which constrains the time they can devote to travel, even when roads improve. Focus group discussions highlighted that women's trips are more likely to be oriented towards social services, such as health facilities and schools, rather than markets, and that concerns about safety, harassment and overspeeding vehicles influence when and how they travel. Female-headed households, which tend to have fewer assets and weaker access to credit or labour, are especially vulnerable to being "left behind" in terms of mobility gains. Young people, meanwhile, sometimes experience improved roads as a pathway to new opportunities, such as motorcycle taxi services or petty trade, but also face heightened risks related to traffic accidents and exploitative work conditions.

From a Spatial Development Theory perspective, these patterns point to the emergence of "internal peripheries" within districts. The rehabilitated road corridors serve as new axes of integration, but communities located away from the main alignment, or lacking access to affordable transport, remain weakly connected and risk slipping further behind as activity concentrates along the road. From a Sustanaible Livelihood Framework viewpoint, improvements in physical capital have clearly occurred, but households differ in their ability to convert this into enhanced financial, human and social capital. Those with stronger initial asset portfolios are more likely to turn better roads into new livelihood opportunities and more frequent, purposeful travel, while the poorest and most distant households continue to experience constrained mobility. This underlines the importance of reading accessibility not only as a function of infrastructure but as an outcome shaped by the interaction of spatial position, assets and institutions.

Synthesis: Interpreting Accessibility Changes through Spatial Development Theory and Sustainable Livelihood Framework

The evidence presented in this section paints a detailed picture of the accessibility impacts of the Improved Rural Connectivity Project in Nyimba and Chibombo. On one level, the story is straightforward: road rehabilitation has reduced travel times to the BOMA and markets, broadened the range of viable transport modes, increased the frequency of trips for a substantial minority of households and made travel to key services easier and more reliable. In both districts, respondents describe being able to reach markets, clinics and schools more quickly and with fewer seasonal interruptions than before. These changes represent a clear enhancement of physical accessibility and align with a large body of literature that associates rural road improvements with reduced spatial isolation and expanded mobility.

Concurrently, the findings show that these gains are uneven across districts, locations and social groups. Chibombo, already relatively well integrated into national transport corridors, displays highly motorised mobility patterns and strong satisfaction with travel time close to the road, suggesting that rehabilitation there has mainly deepened and stabilised an existing transport economy. Nyimba, starting from a more peripheral position, has experienced more transformative changes: long travel times have fallen, intermediate modes such as bicycles and motorcycles have proliferated and the proportion of households able to reach markets and services within a reasonable time has increased noticeably. Yet even in Nyimba, large differences persist between communities along the corridor and those further away, and between better-off households with transport assets and poorer ones who still walk.

Interpreted through Spatial Development Theory, the Improved Rural Connectivity Project can be seen as a process of partial "centre-periphery recalibration." By upgrading key rural roads, the project has pulled many communities closer, in time and reduced effort, to district and regional centres, shrinking effective distance and

increasing the intensity of interactions. The benefits, however, have diffused unevenly along and away from the rehabilitated corridors, creating a hierarchy of accessibility within each district. Some settlements have been effectively incorporated into new growth axes, while others, especially those off the main road or at the end of poorly maintained branches, remain marginal. In this sense, improved roads reduce certain spatial inequalities while potentially entrenching or reconfiguring others.

Viewed through the Sustainable Livelihoods Framework, the results highlight that infrastructure is a necessary but not sufficient condition for inclusive mobility. Road rehabilitation has strengthened physical capital, but households' ability to translate this into improved mobility and livelihoods depends on their financial resources, access to transport services, social networks and vulnerability context. Those with the means to acquire or hire transport, organise collective travel or leverage new connections to markets are more likely to increase their travel frequency and diversify their activities. For others, especially poorer, more distant or female-headed households, the road remains an under-utilised asset: they recognise that conditions have improved, but costs, time constraints, social norms and safety concerns inhibit the full realisation of potential gains.

Overall, the synthesis suggests that the Improved Rural Connectivity Project has significantly expanded the possibility of movement and access for small-scale farmers in Nyimba and Chibombo, but the realised benefits are filtered through spatial and social structures. Rural road rehabilitation emerges as a necessary foundation for improving accessibility and mobility, yet not a standalone solution. Without complementary interventions in affordable transport services, last-mile connections, livelihood support and road safety, the risk is that improved roads disproportionately serve those already better positioned to benefit. These insights provide an important bridge to the conclusion and policy recommendations, where the implications of these differentiated accessibility outcomes for the design of future rural road programmes in Zambia are considered in more detail.

CONCLUSION AND POLICY RECOMMENDATIONS

This paper set out to examine how rural road rehabilitation under the Improved Rural Connectivity Project has altered market accessibility and everyday mobility for small-scale farmers in Nyimba and Chibombo districts. The analysis has shown that improved roads have substantially reduced travel times to the BOMA and main markets, diversified transport modes, and made travel to key services easier and more reliable for many households. At the same time, the findings demonstrate that these gains are spatially and socially differentiated, shaped by distance from the rehabilitated road, pre-existing asset bases and broader demographic and institutional contexts.

From a Spatial Development Theory perspective, the Improved Rural Connectivity Project has clearly narrowed some spatial disparities: peripheral communities, particularly in Nyimba, are now more closely integrated into district centres and regional growth networks through shorter, more predictable journeys. In Nyimba, travel times under 90 minutes to the BOMA or market rose from 21.5% to 68.2%, while in Chibombo the share increased from 16.2% to 55.9%, indicating a significant compression of time-space distance in both districts. Yet the magnitude and nature of change differ: in Nyimba, improvements were transformative, enabling previously isolated communities to access input and output markets more regularly; in Chibombo, already advantaged by proximity to Lusaka and existing corridors, rehabilitation mainly reinforced efficiency and reliability rather than inducing a major structural shift.

Within the Sustainable Livelihoods Framework, the results confirm that road rehabilitation has strengthened physical capital by improving mobility and accessibility, which in turn has supported gains in financial, human and social capital for many farmers. Households reported easier access to markets, clinics and schools, more frequent trips for trade and service use and greater confidence that roads would remain passable during the rainy season. However, the analysis also shows that these benefits are constrained by weak transport services, limited access to affordable credit and unequal ownership of intermediate means of transport such as bicycles and motor cycles. Further, improved market accessibility "translated into stronger financial capital for farmers, though the benefits were constrained by weak transport services and limited access to affordable credit," so that equitable utilisation of access remains contingent on complementary interventions.

Empirically, this paper contributes district-level, mixed-methods evidence on the intermediate accessibility impacts of rural road rehabilitation in Zambia. It shows that Improved Rural Connectivity Project roads delivered a 40 - 50% reduction in average travel time to administrative centres across Nyimba and Chibombo, expanded the use of motor vehicles and intermediate modes for BOMA travel, and increased perceived ease of access to key social and economic services for more than 70% of surveyed households. Conceptually, the study demonstrates the value of combining Spatial Development Theory and Sustainable Livelihood Framework to interpret how infrastructure investments reorganise rural space while producing differentiated mobility outcomes across locations and social groups.

Simultaneously, the findings underline the limits of infrastructure as a standalone development instrument. Roads have opened a "window of opportunity" by lowering spatial barriers, but the conversion of this opportunity into improved livelihoods depends on whether households can access affordable transport, credit, information and supportive institutions. Without such support, there is a risk that improved roads primarily benefit those already better positioned to take advantage of them, while poorer and more distant households remain relatively immobile. This echoes the broader conclusion of the research that infrastructure "is not a panacea; it must be complemented by enabling policies, institutional linkages and social equity measures to achieve inclusive and sustainable rural development."

Policy Recommendations

On the basis of these findings, several policy recommendations emerge for government, development partners and local authorities designing and implementing rural road programmes such as the Improved Rural Connectivity Project:

Plan roads as part of integrated connectivity systems, not isolated projects. Road rehabilitation should be embedded within broader spatial planning that connects peripheral villages to main corridors via feeder links and tracks, reducing distance-decay effects and ensuring that benefits reach households beyond the immediate roadside band. This implies prioritising "last-mile" and "first-mile" connections in future investment plans, especially for settlements located more than 2 - 5 km from primary rehabilitated roads.

Finance the first mile and strengthen rural transport services. To convert potential accessibility into realised mobility, programmes should explicitly support intermediate and low-cost transport options for small-scale farmers. The research highlights measures such as promoting financing for intermediate means of transport, agent banking and savings groups to help households overcome credit constraints. Scheduled, fixed-time route services on market days, using minibuses or motorcycle-taxi cooperatives, can convert potential trips into actual trips, particularly benefiting women traders, elderly farmers and those with limited personal transport assets.

Address affordability and equity in access. Given that many households still rely on walking or bicycles and cite lack of money for transport as a barrier, targeted support is needed to ensure that improved roads do not exacerbate inequalities. Options include facilitating group ownership of intermediate transport through cooperatives, piloting voucher schemes or negotiated fare ceilings for key routes, and integrating road projects with inclusive financial services that enable poorer households to invest in mobility-enhancing assets.

Mitigate negative externalities and enhance road safety. While satisfaction with improved access is high, many households, especially those within 2 km of the road, report concerns about dust, overspeeding, proximity of the road to homesteads and loss of trees and crops. Policy responses should include dust control (e.g. vegetation buffers, water spraying in sensitive zones), traffic-calming measures near schools and dense settlements, safe shoulders and crossings for pedestrians, and replanting of trees lost during road widening. These steps would help ensure that improved connectivity enhances, rather than undermines, local well-being and environmental quality.

Adopt gender- and youth-sensitive approaches to mobility. The study shows that women and youth experience roads differently, with women often prioritising trips to health and education services and facing safety and time constraints, while young people may engage in new transport-related livelihoods but face

associated risks. Infrastructure programmes should therefore embed gender- and youth-sensitive programming, for example by targeting female-headed households with bundled support packages that combine access to transport assets, market information and business development services, and by promoting safe, decent work conditions in emerging rural transport and logistics services.

Monitor accessibility and livelihood outcomes, not just kilometres of road. Finally, monitoring frameworks for rural road programmes should move beyond engineering indicators to track how accessibility and mobility actually change for different groups over time. As the study suggests, institutionalising continuous monitoring of livelihood outcomes, aligned with the dynamic diffusion model of the Spatial Development Theory and the adaptive resilience of the Sustainable Livelihood Framework, would allow implementers to adjust interventions as new inequalities or bottlenecks emerge. Indicators might include journey times, frequency of trips by purpose and mode, user satisfaction, affordability and distributional effects across gender, age and distance bands.

Limitations and Directions for Further Research

The conclusions of the paper should be read in light of several limitations. First, analysis relies partly on respondents' recall of pre-rehabilitation conditions, which may be affected by memory bias despite efforts to anchor questions to specific periods and events like the COVID pandemic. Second, the data capture intermediate impacts relatively soon after the completion of the Improved Rural Connectivity Project works; longer-term patterns of mobility and market engagement may evolve as transport services adjust and households adapt their strategies. Third, the focus on two districts limits the generalisability of results to other regions of Zambia, although the contrasting characteristics of Nyimba and Chibombo provide valuable comparative insight.

Future research could address these limitations by conducting longitudinal studies that track mobility, market participation and livelihood outcomes over time in Improved Rural Connectivity Project and non- Improved Rural Connectivity Project areas; by expanding the comparative lens to additional districts and road typologies; and by integrating time-use, gendered safety and detailed transport-service data into the analysis. Such work would deepen understanding of how rural road investments interact with wider socio-economic processes, and help design connectivity strategies that do not merely link places, but also expand genuinely inclusive opportunities for the rural poor.

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