
| RESEARCH ARTICLE

Effects of Market Costs Due to Rural Road Infrastructure on the Livelihood Outcomes of Small-Scale Farmers in Kenya

Stellah Riunguh¹ ✉ Maurice Sakwa² and Assumpta Kagiri³

¹²³*Jomo Kenyatta University of Agriculture and Technology, Kenya*

Corresponding Author: Stellah Riunguh, **E-mail:** striunguh@gmail.com

| ABSTRACT

This study examines the effects of market costs due to rural road infrastructure on the livelihood outcomes of small-scale farmers in Kenya. While road infrastructure is widely acknowledged as a catalyst for rural development, few studies have explicitly examined its effect on specific market-related costs, like product pricing and access to buyers, and how these translate into livelihood outcomes. Employing a pragmatic research philosophy, the study utilized a descriptive survey design targeting 395 households located within a one-kilometer radius of a rural road commissioned in the Upper Eastern region of Kenya between 2009-2013. Data were collected through structured questionnaires and analyzed using descriptive statistics and linear regression models. The findings revealed that most farmers experienced improved pricing of bananas post-road commissioning and increased access to buyers. However, regression analysis indicated that pricing of output products had no statistically significant effect on livelihood outcomes, suggesting that higher prices alone do not necessarily lead to improved household outcomes. In contrast, access to buyers had a significant positive relationship with livelihood outcomes, showing the significance of connectivity and market costs. The study concluded that the primary pathway through which rural road infrastructure affects livelihood outcomes is not necessarily by increasing product prices, but by expanding market access for buyers and reducing reliance on intermediaries. The study concluded that enhanced buyer access leads to improved household income and food security, two core components of rural livelihood outcomes. Based on these findings, the study recommends strategic investment in rural roads, support for direct-to-market platforms, and integrated infrastructure-agriculture programs to ensure sustainable livelihood improvements for smallholder farmers in Kenya and similar contexts.

| KEYWORDS

Market Costs, Livelihood Outcomes, Small-Scale Farmers, Rural-Road Infrastructure, Market Intermediaries, Product Output, Buyer access

| ARTICLE INFORMATION

ACCEPTED: 23 July 2025

PUBLISHED: 12 September 2025

DOI: 10.61424/rjbe.v3.i2.403

1. Introduction

Rural livelihoods consist of various activities, including gathering, herding, cultivation, hunting, wage labor, hawking, and trading, among others. These activities supply cash, food, and various goods to meet human needs and improve living conditions. The examination of these livelihood activities is essential for assessing the parameters of sustainable living in rural settings, especially regarding resilience, asset development, and environmental management. Natarajan, Newsham, Rigg, and Suhardiman (2022) define sustainable living as the ability of individuals to cope with and recover from shocks and stressors, while simultaneously enhancing their assets and capabilities in the present and future, without depleting natural resources.

Copyright: © 2025 the Author(s). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) 4.0 license (<https://creativecommons.org/licenses/by/4.0/>). Published by Bluemark Publishers.

The combination of various livelihood resources enables the pursuit of diverse livelihood strategies. Consequently, this contributes to achieving outcomes such as enhanced livelihoods. This study primarily examined the livelihood outcomes influenced by livelihood resources and strategies, as outlined by the sustainable livelihood approach. Tambe (2022) stated that the capacity to pursue diverse livelihood strategies is contingent upon the essential social, material, tangible, and intangible assets individuals possess. This is known as the 'capital' base, which serves as the source of productive streams and the foundation for livelihoods. This study examined the economic assets identified by DFID in 2002, which encompass production equipment, basic infrastructure, and technologies essential for implementing diverse livelihood strategies (Fayad, Nguyen, & Nguyen, 2023).

The development of physical infrastructure is essential for poverty alleviation and accelerated economic growth (Govinda, 2020). Consequently, the creation of employment, production costs, investment opportunities, and access to markets are contingent upon the quality of infrastructure, such as transportation. Many developing nations prioritize poverty reduction through infrastructure development. The World Bank (2023) has identified infrastructure improvement, particularly in roads, as a means of alleviating poverty in developing countries. Notably, it is estimated that 15% of World Bank expenditures from 1995 to 2010 were allocated to infrastructural development projects, with at least 58% of this total directed towards Africa (World Bank, 2023). And so, improved infrastructure contributes to poverty reduction and economic growth via several mechanisms, including decreased transportation costs, lowered consumption costs, and reduced production costs for goods and services. This study assessed the impact of market costs associated with rural road infrastructure on the livelihood outcomes of small-scale farmers.

1.1 Statement of the Problem

A study by the Kenya Institute of Public Policy Analysis (KIPPRA, 2021) revealed that the welfare, productivity, and safety of both urban and rural populations are significantly influenced by infrastructural development in their regions, as well as the connections of infrastructure to local, national, and provincial centers of administration and markets. Infrastructural activities typically encompass capital facilities, social overheads, and measures that distribute techno-economic characteristics, such as spillovers from users to non-users and economies of scale, to enhance the productive capacities of both agricultural and non-agricultural households and industries. As infrastructure serves as an intermediary input, the quality and cost-effectiveness of infrastructural services contribute to enhanced price competitiveness. Enhancing communication between sellers and buyers, as well as between buyers and producers, while facilitating safe and timely delivery of commodities, can improve non-price competitiveness through infrastructure development. For producers, the transport cost of moving commodities from production sites to market impacts productivity, particularly when prices are predetermined. In instances where costs are passed on to consumers, transportation expenses diminish the price competitiveness of producers.

The World Bank (2023) reported that road infrastructure benefits local farmers by reducing the costs associated with transporting agricultural products to markets, thereby extending the distance to breakeven locations. This results in an expansion of cultivated land and an increase in cash crop production. Calvo (2020) noted that enhancing road infrastructure can decrease production costs by lowering input prices, such as information and equipment, via improved agricultural extension services. This ultimately raises farm gate prices and farm income. KIPPRA (2021) identified two avenues for enhancing infrastructure to improve living outcomes in Kenya: the connection between economic growth and infrastructure, and the direct role of infrastructure in the pro-poor growth process. This study assessed the effect of market costs associated with rural road infrastructure on the livelihood outcomes of small-scale farmers, aiming to examine the two extremes and delineate the scenario in rural Kenya.

1.2 General Objectives

The general objective of this study is to examine the effect of market costs due to rural road infrastructure on the livelihood outcomes of small-scale farmers.

2. Literature Review

Investments in road infrastructure are justified by their critical role in facilitating market integration. This results in reduced transportation costs and enhances farmers' access to markets for their products. They reduce

transportation costs for both buyers purchasing agricultural commodities at the markets and farmers selling their crops in those markets. This indicates that enhanced road infrastructure influences demand through fluctuations in transport costs for consumers and affects supply by altering transport expenses for producers (Petrovic & Vasijelevic, 2020; Dumas, 2020; Xu, Chase, & Peng, 2021). The aforementioned scholars conducted a study on road infrastructure broadly. This raises the question of whether the effect is applicable to both urban and rural roads. This study focused on rural roads to determine if this observation is present in rural areas.

Road transport, as examined by Nagesso and Edae (2020) and Haile (2023), can result in a reduction of production costs by decreasing the prices of delivered inputs, enhancing access to information and equipment, and improving agricultural extension services. The impact includes an enhanced net farm gate price and increased farm incomes; however, the extent of these outcomes is contingent upon the competitiveness of the transport service market. Furthermore, all-weather road access enhances income derived from agricultural activities and contributes to price stability, thereby allowing the impoverished to improve risk management and reduce vulnerability. Furthermore, enhanced road access facilitates labor force mobility and expands opportunities within households. Haile (2023) conducted a study in Bangkok, whereas the present study examines Kenya, a developing country, to assess the comparability of the results with those from Bangkok. This study specifically examines small-scale farmers, in contrast to previous research that generalized agricultural conditions across both large and small-scale farming contexts.

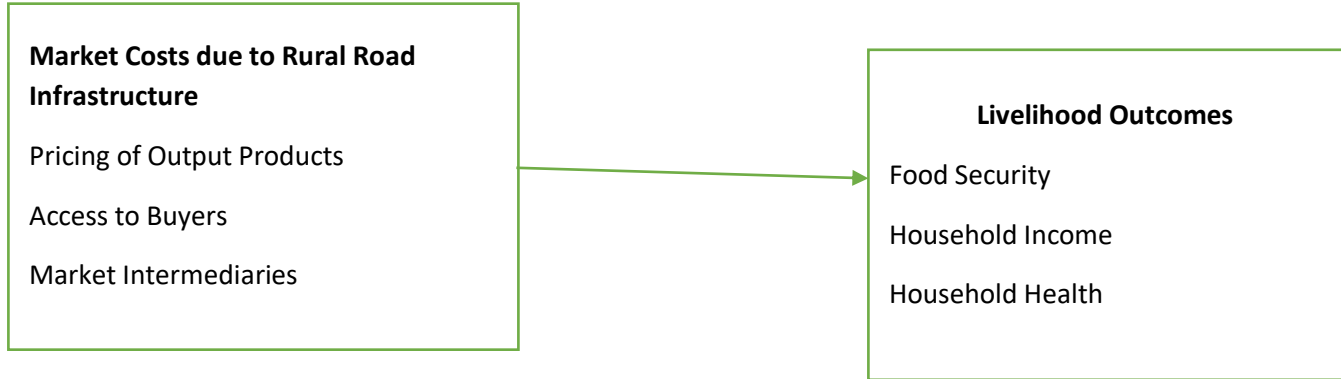
Previous research has demonstrated a notable relationship between road infrastructure and the reduction of trade costs, attributed to improved market access. Ludwig, Nagarajan, and Zaman (2019) employed a fuzzy regression discontinuity design to investigate the impact of feeder roads on agricultural markets. The research indicated that these roads significantly reduced the market prices of local agricultural commodities. Sulaiman (2022) developed a multi-sector model calibrated with data from Uganda to analyze the relationship between agricultural productivity and transportation costs. It was found that rising transportation costs resulted in heightened agricultural specialization, which is inefficient, and that investment in road infrastructure would lead to significant labor reallocation to the non-farm economy. The two studies do not establish a direct relationship between transport availability and market costs, thereby creating a gap that the current study addresses. This study investigates the direct relationship between transport access and market costs, building on existing research in the field.

Irandu (2022) performed an impact analysis of the Nombe-Makete Road project in Tanzania, which included bridge construction, enhancement of feeder roads, and routine maintenance of rural roads. The study revealed an enhancement in vendor participation in local markets, alongside an increase in the variety of consumer goods and agricultural commodities available. The geographical scope of the agricultural products market expanded significantly, accompanied by a notable increase in sales of agricultural products and an enhancement in the availability of agricultural inputs. This analysis focused on a specific road in Tanzania, and it remains unclear if the findings are applicable to other projects. The study did not demonstrate the replicability of these findings in other African countries. This study examined a particular road project in the upper eastern region of Kenya to determine if the findings of Lucas and Jones align with those observed in Kenya.

A household-level analysis conducted in Tigray by Negash, Etsay, Aregay, & Kidu (2023) demonstrated that access to roads and towns influenced various agricultural practices, including increased labor, fertilizer, and oxen usage. Furthermore, access to towns was associated with income disparities among households. Abebe (2022) utilized comparable data from Amhara to demonstrate that road access and market availability are linked to variations in input usage and land management practices. The study revealed that the effects differed between low and high rainfall regions, with crop yields being higher in high potential areas located farther from the road. Additionally, there were no significant impacts of market and road access on produce during low rainfall seasons. The studies, conducted in a single region, yielded contradictory findings, prompting the researcher to investigate which of these findings pertains to the situation in Kenya. This study concentrated on Kenya, which shares similar conditions with the Ethiopian highlands, but specifically focused on small-scale farmers. A study by Yamanos and Kisima (2019) in Kenya indicated that access to markets influenced both livestock and crop incomes. The analysis indicated that per

capita income and per capita livestock income decreased to USD 8.7 and USD 5.4, respectively, for households with these incomes at every 10 km increment from urban centers. Furthermore, both incomes decreased further in the presence of a greater number of loose surface roads compared to tarmac roads.

Figure 1: Conceptual Framework



Market costs in rural agricultural economies include both direct financial costs like transport fees and market levies and indirect economic costs that affect farming profitability. Pricing of output products, market intermediaries, and access to customers were utilized to reflect market costs driven by rural road infrastructure. Chagalima and Ismail (2022) found that farmers in isolated rural areas with poor road connectivity generally sell their produce for less since few purchasers will travel there. Also, poor rural roads increase the gap between farm-gate and retail market prices, reducing farmers' net incomes, according to Dorosh et al. (2022). Second, opportunity costs and transaction limits determine buyer access. Farmers must often use middlemen or brokers, who give cheaper rates and capture part of the value chain, because they have limited access to buyers. Lost direct sales and profits result from this situation.

Poor infrastructure limits farmers' capacity to sell how and to whom, reducing their negotiating power and dependency on intermediaries, according to Nyathira and Njiraini (2022). However, better road connectivity lets more purchasers reach farms, increasing market options and price competitiveness. Thus, according to this study, pricing of output product, market intermediaries, and buyer access are ways through which small-scale farmers face market costs, tying rural road infrastructure to livelihood outcomes. Thus, pricing of output products, market intermediaries, and buyer access are not simply outcomes but are channels through which market costs are experienced by small-scale farmers, directly linking rural road infrastructure to livelihood outcomes.

3. Methodology

This research employed a pragmatic philosophy that synthesizes aspects of both positivism and interpretivism. Pragmatism, as a philosophical perspective, is based on acts, tangible circumstances, and their outcomes, rather than theoretical or antecedent factors. It underscores actual implementation, concentrating on effective solutions for real-world issues. The pragmatic approach, instead of adhering to a singular methodological perspective, emphasizes the research problem and utilizes several approaches as needed to achieve a thorough grasp of the subject (Fischoff & Broomell, 2020).

The research employed a descriptive survey design, as outlined by Mugenda & Mugenda (2019), which involves the collection of data to address questions pertaining to the subject of study in its current state. This study primarily utilized a descriptive research design through cross-sectional data, as indicated by Bordens and Abbott (2021). The study employed reflexive comparison to analyze the treatment area pre- and post-intervention of the road project, given the absence of a control area (Ide & Beddoe, 2024); this method was employed by Irandu (2022) in their impact analysis of the Ndomba-Makete road in Tanzania. This study employed a correlational design to assess the relationship between rural road infrastructure and agricultural practices, and utilized cluster sampling, focusing on

households situated along the rural road of focus. The fixed corridor approach established by Zhang and Park (2021) was utilized to identify these households, designating the road as the central axis of influence and encompassing households located within a one kilometer radius to the east and west of the road. From a population of 38,890 households, a total of 395 households were sampled for this study.

4. Results

4.1 Livelihood Outcomes of Small-Scale Farmers

The dependent variable of this study was livelihood of small-scale farmers. The study sought to establish the livelihood outcomes of the banana farmers and the results are summarized in table 0

Table 0. Livelihood Outcomes of Farmers

1- Strongly Disagree, 2- Disagree, 3-Undecided, 4- Agree, 5-Strongly Agree

Statement	Mean	Median	S.D
My household has had enough food for daily consumption	3.5	4.0	1.02
My household has had enough food for future usage	2.3	2.0	0.97
My household is taking a more balanced diet since the road was commissioned	3.6	4.0	0.5
Visits to the hospitals when unwell, in my household, have increased since the road was commissioned.	3.1	4.0	0.97
My household members have portrayed an improvement in general health since the roads were commissioned	2.4	2.0	0.92
My household expenditure on health-related issues has reduced since the road was commissioned.	2.4	2.0	0.99
The road has brought more income in my household	3.7	4.0	0.87
My income is sufficient for my family's current needs	3.6	4.0	0.93
My income is sufficient for my family's future needs	2.4	2.0	0.99
I am able to save money from my income for my family's rainy days	2.4	2.0	0.99
Mean: Strongly Disagree (1.00-1.49); Disagree= (1.50-2.49); Undecided = (2.50-3.49); Agreed = (3.50-4.49); Strongly Agreed (4.50-5.00)			

The data indicate that although the rural road has enhanced the current livelihood requirements of the farmers, it has not addressed their future needs. This finding consequently prompts an inquiry into the stability of farmers' livelihood outcomes amidst internal and external challenges, a crucial element for sustainable livelihoods, as articulated by Li, Xu, and Hu (2020). The Sustainable Livelihood Framework, as elucidated by FAO (2021), posits that households must possess sufficient savings to ensure resilience under adverse circumstances. The inability to retain assets for future utilization renders households susceptible and may hinder their ability to attain desired livelihood results. However, the inability to save food or income for the future is attributed to the rising cost of living in Kenya, as noted by Amboko and Mburu (2023), who assert that individuals can scarcely save anything for the future.

The Principal Component Analysis (PCA) extracted only 3 components where component 1 explains 36.73% variance while the second component explains 21.9% of the variance, and the third component accounts for 15.2% variance in the livelihood outcome. This brings the total explained variance to 73.87% which imply that, the remaining 26.23% variance is explained by others variables not considered in the study. These three components were household income, household health, and food security.

4.2 Pricing of Output Products

The study sought to find out whether the pricing of bananas had improved after the road was commissioned. The findings are shown in Table 1

Table 1 Pricing of bananas have improved after road was commissioned

	Frequency	Percentage
Yes	330	90%
No	37	10%
Total	367	100%

The results indicated that 90% of the participants reported that the road development enhanced banana pricing. Upon further investigation, farmers reported that prior to the road's commissioning, they sold bananas for roughly Ksh. 200, however, post-construction, they are able to sell them for Ksh. 500. The predominant factor cited was heightened demand. A farmer stated, "Prior to the road's construction, we sold bananas exclusively to individuals in our vicinity. We now have purchasers traveling from the city". A further inquiry from those who had indicated that prices had not improved said that the influx of customers has led to an oversupply of bananas in the market, resulting in diminished prices. Additionally, some farmers noted that prior to the commissioning of the road, they were able to inflate prices, but with enhanced road access, they can no longer do so, leading to lower prices. This finding is corroborated by Haile (2023), who noted that villages with well-constructed rural roads were able to sell their agricultural products at relatively higher prices than those without road access. Findings of further analysis are summarized in Table 2

Table 2 pricing of Output Products

1- Strongly Disagree, 2- Disagree, 3-Undecided, 4- Agree, 5-Strongly Agree

Statement	Mean	Median	S.D
I am able to quote a higher price on my bananas since the road was constructed	3.75	4.00	0.68
The banana prices have improved since the road was constructed	3.66	4.00	0.72
I am selling my bananas at a higher price since the road was constructed	3.83	4.00	0.72

Mean: Strongly Disagree (1.00-1.49); Disagree= (1.50-2.49); Undecided = (2.50-3.49); Agreed = (3.50-4.49); Strongly Agreed (4.50-5.00)

The study shows that majority of the responses were agreement to the fact that the banana farmers are able to quote a higher price on their bananas since the road was commissioned, that the banana prices have improved since the road was commissioned, and that the banana farmers are selling their bananas at a higher price since the road was commissioned. This finding is in line with the findings made by Haile (2023), who said that farmers in communities with a good road network are able to sell their farm produce at a higher price than those without a good road network.

4.3 Access to Buyers

The study examined whether the banana farmers had more customers since the road was commissioned. The findings are shown in Table 3

Table 3 More customers since the road was constructed

	Frequency	Percentage
Yes	352	96%
No	15	4%
Total	367	100%

The finding showed that 96% of the farmers said that they had more customers since the rural road was commissioned. This finding supports the findings made by Wudad et al. (2021) in rural Ethiopia. He observed that many people in the rural areas live far away from the major markets and other socio-economic service centers, thus, improving road infrastructure improves the mobility of people, allowing them to visit markets easily.

Further analysis are summarized in table 4

Table 4 Statements on Access to Buyers

1- Strongly Disagree, 2- Disagree, 3-Undecided, 4- Agree, 5-Strongly Agree

Statement	Mean	Median	SD
There is a higher demand for my bananas in the farm since the road was constructed	3.88	4.00	0.47
More Customers are able and willing to reach my farm to buy bananas from the farm since the road was constructed	3.81	4.00	0.59
There is a higher demand for bananas at the market since the road was constructed	3.82	4.00	0.54

Mean: Strongly Disagree (1.00-1.49); Disagree= (1.50-2.49); Undecided = (2.50-3.49); Agreed = (3.50-4.49); Strongly Agreed (4.50-5.00)

The findings showed that majority of the farmers responded to be in agreement with the statements that; there is a higher demand for their bananas in the farm since the road was commissioned, that more customers were able and willing to reach their farms to buy bananas from the farm since the road was commissioned, and that there was a higher demand for bananas at the market since the road was commissioned. This finding supports the results of the study conducted by Morgan (2019), who said that road infrastructure had an influence on the commercialization of farming in the rural areas, by enhancing the access of buyers to produce in both the markets and the farm gates, for all sizes of farms.

The study further conducted a cross tabulation between pricing of output products and access to buyers. The findings are presented below.

Table 5. Cross tabulation of pricing of products and access to buyers

		Cross tabulation of pricing of products and access to buyers		
		More customers after road was constructed.		
		Yes	No	Total
Pricing of bananas	Yes	331	0	331
Access to buyers	No	20	16	36
Total		351	16	367

The findings showed that all the farmers who said that the rural road has improved the pricing of their bananas, agreed that they were able to access more customers. These results are consistent with previous study by Changalima and Ismail (2022) that showed that greater rural road infrastructure, primarily due to increased market access, results in higher prices for banana growers. On the other hand, poor road conditions, raise transportation costs, which are then passed down as reduced farm-gate prices. Thus, farmers who claimed that rural roads had boosted banana prices did so because they were able to reach a wider market.

4.4 Market Intermediaries

The study examined whether more brokers were visiting the banana farms since the road was commissioned that before. The findings are presented in table 6.

Table 6 Brokers in the farm after road was constructed

	Frequency	Percentage
Yes	169	46%
No	198	54%
Total	367	100%

The study showed that only 46% of farmers said that there were more brokers in the farm after road was commissioned, while 54% said that they were not more. The majority of the farmers who said that there the brokers were not more, explained that because of accessibility, more customers are able to come and buy directly from the farms. They also pointed out that they preferred selling to customers directly than using brokers. This finding is supported by (Nyathira & Njiraini, 2022), who found out that poor road infrastructure was too costly to farmers, since it affects the marketing channels, limiting their choice of who to sell to. They are thus forced to sell through brokers for lack of alternative channel.

Further analysis on market intermediaries were as follows;

Table 7 Statement on Market Intermediaries

1- Strongly Disagree, 2- Disagree, 3-Undecided, 4- Agree, 5-Strongly Agree

Statement	Mean	Median	S.D
There are more people purchasing bananas at the farm for reselling purposes	3.6	4.00	0.76
More resellers are demanding for our bananas at the market since the road was constructed	3.89	4.00	0.56
More resellers are demanding for our bananas from the farm since the road was constructed	3.79	4.00	0.53

Mean: Strongly Disagree (1.00-1.49); Disagree= (1.50-2.49); Undecided = (2.50-3.49); Agreed = (3.50-4.49); Strongly Agreed (4.50-5.00)

The survey showed that the majority of responses were in agreement that an increased number of individuals are acquiring bananas from the farm for resale, and that demand from resellers for the farmers' bananas at the market has risen since the road's commissioning. Raju (2021) corroborated that rural road infrastructure enhanced the marketing channels for banana growers, enabling them to sell their produce to local traders, who subsequently resell to consumers.

4.5 Factor Analysis

Findings in Table 8 show that two factors were extracted with the pricing of products explaining 63.04 percent of the total variance, while access to buyers explaining 20.78 percent, which brings the total explained variance by the extracted components to 83.83 percent. Factors beyond this study determine about 16.17 percent of the market cost. Thus, the variables extracted were pricing of products and access to buyers as shown in table 8

Table 8: Descriptive Statistics on Market costs

Component	Mean	Std. Deviation	Cronbach Alpha
Pricing of products	3.75	0.68	0.95
Access to buyers	3.81	0.50	0.92

Mean: Strongly Disagree (1.00-1.49); Disagree= (1.50-2.49); Undecided = (2.50-3.49); Agreed = (3.50-4.49); Strongly Agreed (4.50-5.00)

The average response indicates that small-scale farmers in the upper Eastern region concurred that rural road enhances both the pricing of output items and access to buyers in the area. These data demonstrate that the development of rural roads affects not just product cost but also market access. This conclusion is corroborated by Dorosh, Wang, You, & Schmidt (2022), who indicated that enhanced rural roads boost market access by diminishing transportation expenses, expanding buyer reach, and stabilizing farm gate prices. A subsequent study by Dercon, Gilligan, Hoddinott, and Woldehanna (2019) indicates that improved road infrastructure diminishes the price discrepancy between farm-gate and market pricing, enabling farmers to secure enhanced returns for their produce.

4.6 Linear Regression Analysis of Market Costs and Livelihood Outcomes of Small-Scale Farmers

The independent variable of the study was market costs, which were measured using the pricing of output products and access to buyers. The findings are in Table 9

Table 9 Regression Analysis for Market Costs and Livelihood Outcomes

Model	Coefficients		Standardized Coefficients Beta	T	Sig
	Unstandardized B	Coefficients Std. Error			
Constant	8.097	.619		13.072	.000
Pricing of Output Products	-0.024	.126	-0.011	-0.189	.850
Access to Buyers	0.416	.175	0.140	2.378	.018

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	Df1	Df 2	Sig. F Change
	0.135	0.018	0.013	.1462	0.018	3.371	2	364	.252

Predictors: (Constant, Access to Buyers, pricing of Output

ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig
Regression	14.409	2	7.205	3.371	0.035
Residual	778.019	364	2.137		
Total	792.428	366			

The analysis indicates an insignificant negative relationship between the pricing of output products and the livelihood outcomes of small-scale farmers ($\beta = -0.024$; $p = 0.850 > 0.05$). These results indicate that an increase in output product prices may result in a marginal decrease in livelihood outcomes for small-scale farmers, albeit the effect is minimal. An increase in the price of output items relates to a decline in the livelihood results for small-scale farmers, as it indicates counterintuitive economic dynamics. Higher prices may render items less affordable for buyers, resulting in decreased sales. Additionally, if output prices escalate, input costs are anticipated to rise due to price dynamics across value chains, hence diminishing net earnings for farmers, as indicated by Anugwa and Ugwu (2022).

The results indicated a statistically significant positive relationship between access to buyers and the livelihood outcomes of small-scale farmers ($\beta = 0.416$; $p = 0.018 < 0.05$), meaning that enhanced access to buyers augments the livelihood outcomes of small-scale farmers. This indicates that diminishing obstacles between farmers and buyers can improve their livelihood outcomes Ncube (2020).

The model summary indicates a significant coefficient of determination ($R^2 = 0.018$; $p = 0.035 < 0.05$). This indicates that market costs exert a statistically significant influence on the livelihood outcomes of small-scale farmers. The findings indicate that market costs associated with rural road infrastructure account for about 1.8% of the livelihood outcomes for small-scale farmers.

The ANOVA statistic regarding the effect of market costs stemming from rural road infrastructure on the livelihood outcomes of small-scale farmers indicates a F statistic of 3.371. The calculated F-statistic of 3.371 above the critical value of 2.996, and the p-value of 0.035 is below 0.05, indicating that market costs associated with rural road infrastructure significantly affect the livelihood outcomes of small-scale farmers. The findings indicate that changes in market costs resulting from rural road infrastructure substantially influence the livelihood outcomes of small-scale farmers, as evidenced by Omiti, Nyanamba, and McCullough (2020).

Further, the hypothesis test of the study indicated that market costs associated with rural-road infrastructure have a significant effect on the livelihood outcomes of small-scale farmers. Consequently, variations in market costs resulting from rural road infrastructure have a significant effect on the livelihood outcomes of small-scale farmers. The market cost aspect that significantly influenced outcomes was its effect on buyer access, affecting both food security and household income security, as supported by Omiti, Nyanamba, and McCullough (2020). Direct and accessible sales channels for farmers enhance their pricing for produce, resulting in improved household income security and enabling the purchase of additional nutrient-rich foods not cultivated by them. This indicates that policies and interventions ought to prioritize the enhancement of market linkages, including farmer-to-buyer trade platforms, contract farming, and farmers' markets, to improve direct sales for small-scale farmers, as proposed by Lothore and Delmas (2019).

5. Discussion

The research investigated the relationship between market costs associated with rural road infrastructure and the livelihood outcomes of small-scale farmers in Kenya, emphasizing product pricing and buyer accessibility. The results explicitly demonstrated that enhanced rural roads substantially affected farmers' capacity to reach a broader array of buyers, with 96% of participants reporting an increase in buyers following rural road commissioning. This corresponds with research conducted by Wudad et al. (2021) and Changalima and Ismail (2022), which highlight that enhanced access due to road infrastructure improves market costs and price competitiveness for rural farmers.

Access to customers was identified as a statistically significant factor affecting livelihood outcomes, supporting the assertion that physical connectivity allows farmers to engage directly with buyers and circumvent intermediaries. The low regression determinant indicates that market costs account for just a minor fraction of the variability in livelihood outcomes, suggesting the existence of additional significant factors such as training, access to inputs, land size, and social capital.

The pricing of output products does not significantly impact livelihood outcomes. This counterintuitive outcome may be ascribed to many market factors. For example, elevated prices may dissuade bulk purchasers, decrease turnover, or indicate increasing input expenses, so reducing total profitability. It also suggests potential inefficiencies in the market system or exploitative intermediary behaviors that diminish farmers' net profit from enhanced selling prices (Mbarga et. al., 2024).

6. Conclusion

The research shows that rural road infrastructure significantly and positively influences small-scale farmers' access to consumers, hence improving their livelihood outcomes. Despite the lack of statistical significance regarding higher output pricing, rural road infrastructure has facilitated greater buyer access, resulting in improved food security, increased household income, and diminished dependence on exploitative intermediaries. The primary insight is that access to markets rather than elevated prices facilitates significant enhancements in the livelihood outcomes of small-scale farmers. The results underscore the significance of rural road infrastructure as a crucial facilitator of inclusive rural development and sustainable agricultural livelihoods.

One of the limitations faced during this study was that some respondents were sparsely available to fill out the questionnaires, and thus, the researcher had to make some follow-up calls to fill out the questionnaires. Additionally, several terms in the questionnaire were difficult to grasp; thus, the researcher simplified the questions by using simple vernacular terms in the questions. Also, before using the questionnaire in the main study, the

researcher pilot-tested it to address any challenges that the respondents were having, especially in understanding the terminologies.

6.1 Recommendations

Following the findings of this study, the study recommends the following;

1. National and county governments should focus on enhancing rural roads to guarantee all-weather accessibility, therefore reducing seasonal interruptions in market connectivity.
2. Development partners and local governments ought to endorse farmer markets, digital trading platforms, and cooperative marketing models that eradicate intermediaries and enhance farmer-buyer connection, enabling farmers to retain a larger portion of the final price.
3. Rural-road development initiatives must be integrated with input distribution services and other agricultural development initiatives to augment productivity and market preparedness.
4. Further research should examine intervening factors between the effect of market costs due to rural road infrastructure on the livelihood outcomes to offer a more comprehensive picture of rural development dynamics.

References

- [1] Abebe, E. (2022). Determinants of Sustainable Use of Farmlands in Amhara Region, Ethiopia. *European Journal of Sustainable Development Research*, 1.
- [2] Amboko, J., & Mburu, P. (2023, June 30). The shrinking basket: How Kenyas are coping with high living standards. *Business Daily*
- [3] Anugwa, I., & Ugwu, S. (2022). Perceived Effcets of Food Price Inflation on Rural Households Food Security Situation in Enugu State. *Innovative Journal of Agricultural Science*, 221.
- [4] Bordens, K., & Abbott, B. (2021). *Research Design and Methods: A Process Approach ISE, 11th ed.* McGraw Hill.
- [5] Calvo, F. (2020). Road Investment and Traffic Safety. *Sustainability*, 12 (16), 6336.
- [6] Changanima, I. A., & Ismail, I. J. (2022). Agriculture supply chain challenges and smallholder maize farmers' market participation decisions in Tanzania. *Tanzania journal of agricultural sciences*, 21(1), 104-120.
- [7] Dumas, C. (2020). Better Roads, Better off? Evidence on Improving Roads in Tanzania. *SES*.
- [8] Dercon, S., Gilligan, D., Hoddinott, J., & Woldehanna, T. (2019). The Impact of Agricultural Extension and Roads on Poverty and Consumption Growth in Fifteen Ethiopian Villages. *American Journal of Agrivultural Economics*, 91 (4), 1007-1021.
- [9] Dorosh, P., Wang, H., You, L., & Schmidt, E. (2022). Road Connectivity, Population, and Crop Prodcution in Sub-Saharan Africa. *Agricultural Economics*, 43 (1), 89-103.
- [10] FAO. (2019). *The Economic Lives of Smallholder Farmers*. Rome: FAO.
- [11] Fayad, S., Nguyen, T., & Nguyen, M. (2023). Analyzing the Status of Multidimensional Poverty of Rural Households by Using Sustainable Livelihood Framework: Policy Implications for Economic Growth. *Environmnetal Science and Pollution Research*, 30, 16106-16119.
- [12] Fischhoff, B., & Broomell, S. (2020). Judgement and Decision Making. *Annual Review of Psychology*, 71 (1), 331-335.
- [13] Govinda, T. (2020). Infrastructure, Economic Growth, and Poverty: A Review . *Policy Research Working Paper*. Washington DC, USA: World Bank.
- [14] Haile, K. K. (2023). The Impact of Roads on Household Income in Rural Ethiopia. *IFAD*
- [15] Ide, Y., & Beddoe, L. (2024). Challenging Perspectives: Reflexivity as a Critical Approach to Qualitative Social Work Research. *Qualitative Social Work*, 23(4), 725-740.
- [16] Irandu, E. (2022). Impact of Climate Reslient Rural Road Transport on Human Security. *Human Security and Sustainable Development in East Africa*, 151-169.
- [17] KIPPRA. (2021). Road Infrastructure Policies in kenya: Historical Trends and Current Challenges. *Working Paper*. KIPPRA.
- [18] Li, X., Xu, S., & Hu, Y. (2020). Understanding the Rural Livelihood Stability System. *Sustainability*, 12(17).
- [19] Lothore, A., & Delmas, P. (2019, March 20). Market Access and Agricultural Product Marketing. *Market Access and Agricultural Marketing*. Paris, AFC.
- [20] Ludwig, C., Nagarajan, G., & Zaman, L. (2019). Systematic Review of the Effects of Rutal Roads on Expanding Agricultural Markets in Developing Countries. *Social Impact*, 1-64.
- [21] Mbarga Evouna, J. S., Molua, E. L., Djomo Choumbou, R. F., & Kemeni Kambiet, P. L. (2024). Structure and performance of cassava markets: challenges of food security and connecting small farmers to markets in Cameroon. *Frontiers in Sustainable Food Systems*, 8, 1353565.
- [22] Morgan, A. (2019). Effect of road transport accessibility on agricultural produce marketing and livelihoods of farmers in the Kasena-Nankana West District of Ghana. *The Journal of Development Practice*, 5.

- [23] Nagesso, H., & Edae, M. (n.d.). Environmental Implications of Universal Rural Road Access Program (URRAP) roads in Southwestern Ethiopia. *Multidisciplinary Journal of Education, Social and Technological Sciences*, 1-17.
- [24] Natarajan, N., Newsham, A., Rigg, J., & Suhardiman, D. (2022). A Sustainable Livelihoods Framework for the 21st Century. *World Development*, 155, 105.
- [25] Negash, T., Etsay, H., Aregay, M., & Kidu, G. (2023). Livelihood Options of Landless Rural Households in Tigray Region, Northern Ethiopia: Evidence from Selected Districts.
- [26] Ncube, D. (2020). The Importance of Contract Farming to Small-Scale Farmers in Africa and the Implications for Policy: A Review Scenario. *The Open Agricultural Journal*, 14 (1).
- [27] Nyathira, E., & Njiraini, J. (2022). *Access to Maize Retail Markets and the Impacts of Rural Road Infrastructure in Kenya*. Nairobi: KIPPRA.
- [28] Omiti, J., Nyanamba, T., & McCullough, E. (2020). Factors Influencing the Intensity of Market Participation by Smallholder Farmers: A Case Study of Rural and Peri-Urban Areas in Kenya. *African Journal of Agricultural and Resource Economics*, 3 (1), 57-82.
- [29] Petrovic, S., & Vasijelevic, Z. (2020). The impact of Transportation Costs on Economic Performances in Crop Production. *Ekonomika* 67 (3), 683-697.
- [30] Raju, S. (2021). Economic analysis of production, marketing and export performance of banana from western Maharashtra, Unpublished Doctoral dissertation, mahatma phule krishi vidyapeeth.
- [31] Sulaiman, M. (2022). Multisectoral Programming in Action: Impact Evaluation of Uganda Multisectoral Food Security and Nutrition Project (UMFSNP). *Global Agriculture and Food Security Program*. Uganda.
- [32] Tambe, S. (2022). *Evolution of Rural Livelihood Approaches*. Springer.
- [33] World Bank. (2023). Impact of Infrastructure on Development Outcomes. *Qualitative Review*. Washington DC, USA: World Bank.
- [34] Wudad, A., Naser, S., & Lameso, L. (2021). The impact of improved road networks on marketing of vegetables and households' income in Dedo district, Oromia regional state, Ethiopia. *Heliyon*, 7(10).
- [35] Yamano, T., & Kijima, Y. (2019). The associations of soil fertility and market access with household income: Evidence from rural Uganda. *Food Policy*, 35(1), 51-59.
- [36] Zhang, S., & Park, S. (2021). Study of Effective Corridor Design. *Environmental Psychology*, 12.