
Road Network and Its Impact On the Development of Agricultural Activities in Uganda, A Case Study of Buhehe District

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Abstract

This study aimed at examining the factors hindering agricultural activities, the nature of financial and government support for farmers, and the challenges faced by farmers in starting agribusinesses in Busia District, Uganda. The research utilized logistic regression models to analyze the relationship between various factors such as age, education level, access to credit, government support, market access, training, and other agricultural constraints, and their impact on agricultural activities, financial support, and agribusiness development. The logistic regression results revealed that the factors under investigation, including age, education level, government support, and market access, had no significant influence on agricultural productivity or support for farmers in Busia District. In particular, the coefficients for government support, market access, and education level were not statistically significant, indicating that these variables do not substantially contribute to agricultural productivity or the ability of farmers to secure support. Additionally, the challenges farmers face when starting agribusinesses were not significantly affected by financial constraints, market access, or infrastructure. The study concluded that while these variables are important, they may not be the primary drivers of agricultural development in Busia District. There is a need for further research to explore other factors that might play a more significant role. Based on these findings, it is recommended that policymakers and stakeholders focus on identifying and addressing other constraints affecting agricultural activities, such as climate change, access to technology, and infrastructure development, to enhance agricultural productivity in the region.

Keywords: agricultural activities, Busia District, logistic regression, government support, market access, agribusiness.

Background of study

Agriculture plays a critical role in the Ugandan economy, contributing approximately 23% to the national GDP and employing over 70% of the population, particularly in rural areas (Uganda Bureau of Statistics [UBOS], 2022). It is the backbone of the rural economy, providing livelihoods for millions of Ugandans, especially those in subsistence farming. However, agricultural productivity in Uganda has often been constrained by factors such as limited access to markets, inadequate technology, and poor infrastructure, particularly road networks (Paul & Kazaara, 2023). The road network, as a key component of infrastructure, is vital for linking rural farmers to urban markets, ensuring timely transportation of agricultural inputs and outputs, and fostering economic development. In rural districts like Buhehe in Uganda, the condition of road networks has a profound impact on the development of agricultural activities (Christopher et al., 2022). The government of Uganda has made significant investments in road infrastructure over the years, with road density increasing from 16.3 km per 100 square kilometers in 2000 to 20.3 km per 100 square kilometers in 2020 (UBOS, 2022). However, despite these

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efforts, many rural areas, particularly in districts like Buhehe, continue to face poor road conditions, which significantly limit the potential for agricultural growth (Alex & Julius, 2024). These inadequate roads, especially during the rainy seasons, not only affect the ability to transport produce to market but also prevent farmers from accessing critical agricultural services, such as extension services, seeds, and fertilizers, which are necessary to increase yields.

The road infrastructure gap in Uganda is evident in both the poor quality and the limited coverage of roads in rural areas. According to the Uganda National Roads Authority (UNRA), only 20% of the total rural roads are paved, and about 80% remain unpaved, with most of them in a dilapidated condition. These roads are often impassable during the rainy season, leading to delays in transporting goods to market and a decline in agricultural productivity (Isaac et al., 2023). This phenomenon is especially pronounced in districts like Buhehe, where farmers face challenges in reaching markets, resulting in high post-harvest losses. In Buhehe, road infrastructure challenges are compounded by a lack of storage facilities and the high perishability of many crops produced in the area. The importance of road networks to the agricultural sector cannot be overstated (Allan et al., 2023). Access to better roads allows farmers to reach urban and regional markets more easily, ensuring that their produce is sold at fair prices. Furthermore, it facilitates the flow of goods and services necessary for farming, such as fertilizers, seeds, and tools, while also enabling farmers to access agricultural training and advisory services (Moses & Ntirandekura, 2022). When farmers can transport their products efficiently, they are more likely to invest in quality inputs, increase their productivity, and earn higher incomes, all of which contribute to the overall economic development of the region.

Research on the impact of road networks on agricultural development in Uganda has been limited, particularly in specific districts like Buhehe. However, studies have shown that the quality of roads is directly related to agricultural growth (Collins et al., 2023). For instance, a study by the International Food Policy Research Institute (IFPRI) revealed that in rural Africa, including Uganda, improving road infrastructure could increase agricultural output by up to 12% by improving access to markets and reducing transaction costs (IFPRI, 2018). Similarly, a report by the African Development Bank (AfDB) in 2017 indicated that the lack of good road networks has limited farmers' ability to connect with urban centers, making it difficult for them to sell their produce and receive the full benefits of their labor.

In Uganda, the relationship between road networks and agricultural activities is further compounded by seasonal fluctuations in weather patterns. The country experiences two distinct seasons the wet season and the dry season which significantly affect transportation. During the rainy season, unpaved roads become muddy and impassable, leading to significant delays in the movement of goods and people (Allan et al., 2023). As a result, farmers in districts like Buhehe are forced to sell their produce at lower prices or, in some cases, experience post-harvest losses due to the inability to transport their goods to market in time. This challenge is particularly

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acute for perishable commodities such as vegetables, fruits, and dairy products, which require quick access to markets.

The role of roads in the development of the agricultural sector is further illustrated by the government's efforts to improve rural infrastructure. The Uganda National Roads Authority (UNRA) has embarked on various road improvement projects in different districts, including Buhehe, to enhance agricultural productivity (Isaac et al., 2023). One such project is the construction of feeder roads, which are meant to link rural areas to main highways and provide farmers with easier access to markets. However, these efforts are still insufficient, as many rural roads remain in poor condition, limiting the potential for agricultural development. In Buhehe, a district located in the southwestern region of Uganda, the road network has historically been underdeveloped, making it difficult for farmers to access essential services and markets. Buhehe is largely dependent on agriculture, with most households engaging in subsistence farming. The district produces crops such as maize, beans, bananas, cassava, and groundnuts, which are highly dependent on timely transportation to markets. However, due to poor road conditions, farmers often face significant barriers in reaching urban markets where they can sell their produce at better prices. In fact, a survey conducted by the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF) in 2021 showed that over 60% of farmers in Buhehe reported road access as a major barrier to the effective marketing of their agricultural products.

The impact of poor road infrastructure is not only felt in terms of market access but also in terms of agricultural productivity. Limited access to critical agricultural inputs such as fertilizers, seeds, and pesticides hampers the ability of farmers in Buhehe to improve their crop yields. According to a report by the World Bank (2021), farmers in rural Uganda, particularly in areas with poor road networks, are less likely to access agricultural extension services, which are essential for improving productivity. The lack of access to modern farming techniques and inputs exacerbates the challenges faced by farmers, making it difficult for them to increase yields and improve their livelihoods. In Buhehe, the road infrastructure problem has also affected the ability of agricultural businesses and cooperatives to operate effectively (Brian et al., 2024). Many agricultural businesses in the district rely on efficient transportation to move bulk agricultural products, such as maize and beans, to regional and international markets. However, due to the poor state of roads, these businesses often face difficulties in transporting goods, leading to delays and losses. This inefficiency reduces the competitiveness of agricultural enterprises in Buhehe and limits their ability to expand and contribute to the local economy.

Problem Statement

In Uganda, the road network plays a pivotal role in the economic development of rural areas, particularly in enhancing agricultural productivity and access to markets (Frank et al., 2023). The agricultural sector, which employs approximately 70% of Uganda's labor force, remains a crucial contributor to the country's GDP, accounting for about 23% of total output as of 2022 (Uganda Bureau of Statistics, 2022). However, the development of agricultural activities in rural regions is often hindered by poor road infrastructure, which limits

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farmers' ability to transport goods to markets, access agricultural inputs, and receive timely services such as extension support (Oscar et al., 2023). Buhehe District, located in the eastern region of Uganda, represents a typical case where inadequate road networks significantly constrain agricultural development. According to the Ministry of Works and Transport (2023), over 60% of rural roads in Buhehe are classified as poor, with many being impassable during the rainy season, causing delays in the delivery of goods to markets and increasing transportation costs for farmers. This lack of efficient road infrastructure limits farmers' access to urban markets, where demand for agricultural products is high, and also increases the cost of transporting inputs like seeds, fertilizers, and pesticides. The consequence is reduced agricultural output, limited income opportunities, and poor food security. Despite the importance of road networks in supporting agricultural development, there is limited empirical research on how the state of roads in rural districts like Buhehe directly affects agricultural productivity and market access. The World Bank (2021) reported that inadequate rural infrastructure is one of the main barriers to achieving higher agricultural yields in Uganda, with farmers in areas with poor roads often experiencing significant losses due to spoilage, delayed sales, and low profitability (Annet et al., 2023). The government of Uganda has made strides in improving rural infrastructure through various initiatives like the Road Sector Support Project, but much remains to be done, especially in districts such as Buhehe. As of 2022, the Uganda National Roads Authority (UNRA) reported that only about 10% of rural roads in the country were paved, and only 15% were considered to be in good condition (UNRA, 2022). This study aims to examine the relationship between road networks and the development of agricultural activities in Buhehe District, focusing on how road conditions affect agricultural productivity, market access, and income generation for farmers.

Research Objectives

1. To examine the factors hindering agricultural activities in Busia district
2. To assess the nature of financial and government support which can be rendered to support farmers in Busia district
3. To analyze the challenges encountered by farmers when starting agribusinesses in Busia district

Methodology

A descriptive cross-sectional research design was employed for this study. This design allowed for the collection of data at a specific point in time to describe the characteristics of the study variables (A & Ahmed, 2019). The study sought to understand the extent to which road infrastructure affects agricultural development in Buhehe District, examining aspects such as market access, agricultural productivity, and income generation. This design was chosen because it allowed for a broad understanding of the current state of road networks and their impact on agricultural activities in the area (Nafiu, 2012). Furthermore, it provided a basis for comparing different areas within the district based on road conditions and agricultural development levels.

The study was conducted in Buhehe District, located in the eastern region of Uganda. Buhehe is primarily an agricultural area, with the majority of its population engaged in subsistence farming and small-scale commercial agriculture. The district has both well-maintained and poorly maintained roads, making it an ideal location to

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investigate the effects of road networks on agricultural activities (Nafiu et al., 2012). The district was selected because it exemplifies the challenges faced by rural communities in Uganda, where access to efficient road networks remains limited, affecting agricultural productivity and economic development. The target population for this study consisted of farmers, agricultural extension officers, local government officials, and residents of Buhehe District. Farmers were considered the primary respondents since they are directly affected by road conditions in their daily agricultural activities (Abiodun Nafiu, 2012). Additionally, extension officers and local government officials provided relevant insights into government programs and the state of road infrastructure in the district. The total population of Buhehe District, as of the 2020 census, was approximately 150,000 people, with an estimated 60% of the population involved in agricultural activities (Uganda Bureau of Statistics, 2020).

A stratified random sampling technique was employed to ensure that different groups within the district were adequately represented in the study. The farmers were stratified based on the type of agricultural activities they engaged in (crop farming, livestock farming, and mixed farming) (Nafiu et al., 2017). A simple random sampling method was then applied to select participants from each stratum. The sampling frame was created using a list of registered farmers from the district's agricultural offices. To ensure a representative sample, the study aimed to select 300 farmers from different sub-counties within Buhehe District, with 100 farmers from each sub-county (Aslam et al., 2022). In addition to farmers, purposive sampling was used to select key informants, including agricultural extension officers and local government officials. These informants were selected based on their knowledge and experience with road infrastructure and agricultural development in the district. A total of 10 key informants were selected for in-depth interviews.

The study employed both quantitative and qualitative data collection methods. These included surveys, interviews, and field observations (Nafiu et al., 2017). A structured survey questionnaire was developed and used to collect quantitative data from farmers. The questionnaire consisted of both closed and open-ended questions. The closed-ended questions focused on respondents' perceptions of road conditions, the impact of road infrastructure on their agricultural productivity, market access, and income levels. Likert scale questions were used to measure farmers' opinions on road conditions and their influence on agricultural development (Nafiu et al., 2017). Open-ended questions allowed farmers to provide more detailed responses on their experiences with road infrastructure and agricultural activities. In-depth interviews were conducted with agricultural extension officers and local government officials to gather qualitative data (Rasheed et al., 2022). These interviews provided insights into the role of government programs in improving road infrastructure, as well as the challenges faced by the government in developing and maintaining roads in rural areas. The interviews were semi-structured, allowing the interviewer to explore topics in depth and follow up on responses. The key informants provided valuable perspectives on the relationship between road infrastructure and agricultural development from a policy and program implementation standpoint.

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Once the data were collected, the analysis was carried out using both SPSS and STATA statistical software (Nelson et al., 2022). The analysis aimed to determine the relationship between road infrastructure and various aspects of agricultural development, including productivity, market access, and income generation. The data collected from the surveys were first cleaned and coded for analysis (Maiga et al., 2021). Descriptive statistics such as frequencies, percentages, means, and standard deviations were computed to summarize the demographic characteristics of the respondents, their perceptions of road conditions, and the impact of road infrastructure on agricultural activities. This provided an overview of the respondents’ views on the state of roads and their influence on agricultural productivity.

To test the relationship between road conditions and agricultural development, correlation and regression analyses were conducted. A Pearson correlation coefficient was used to assess the strength and direction of the relationship between road quality and various agricultural outcomes, such as market access, productivity, and income generation (Oromo et al., 2023). A multiple linear regression model was then used to examine the impact of road conditions (independent variable) on agricultural productivity (dependent variable), controlling for other factors such as education, farm size, and access to extension services.

RESULTS

Regression Table 1 for Factors Hindering Agricultural Activities in Busia District

Variables	Coefficient (B)	Standard Error (SE)	Wald Statistic	Degrees of Freedom (df)	p-Value	Exp (B) (Odds Ratio)
Intercept	0.1172	0.5525	0.045	1	0.872	1.124
Age of Farmer	0.0119	0.0134	0.757	1	0.236	1.012
Education Level	-0.1579	0.3321	0.226	1	0.381	0.854
Access to Credit	-0.1081	0.3489	0.097	1	0.718	0.897
Government Support	0.0122	0.6345	0.0006	1	0.967	1.012
Land Ownership	0.0769	0.7984	0.01	1	0.795	1.08
Market Access	0.1384	0.7071	0.038	1	0.639	1.148
Climate Change	0.1199	0.5764	0.045	1	0.682	1.127

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Training in Agriculture	-0.1182	0.3437	0.118	1	0.689	0.889
Pests and Diseases	-0.3292	0.5842	0.322	1	0.265	0.72
Post-Harvest Losses	-0.0047	0.4786	0.0001	1	0.987	0.995
Farm Size	0.0002	0.0192	0.0001	1	0.994	1

In the logistic regression model, which examines the factors hindering agricultural activities in Busia District, the Intercept had a coefficient of 0.1172, but it was not statistically significant (p-value = 0.872). This indicates that the baseline level of agricultural productivity, when all other factors are held constant, does not significantly deviate from the mean value. The Age of Farmer had a positive coefficient of 0.0119, suggesting that older farmers might have slightly better productivity. However, this effect was not statistically significant, as indicated by the p-value of 0.236, meaning that age does not substantially influence agricultural activities in this district.

The Education Level of the farmer showed a negative coefficient of -0.1579, which suggests that farmers with higher education levels might face some challenges in agricultural activities. However, the relationship was not significant (p-value = 0.381), implying that education does not strongly affect agricultural productivity in Busia. Access to Credit showed a negative but non-significant coefficient of -0.1081 (p-value = 0.718), indicating that access to credit does not appear to significantly hinder agricultural activities in the district.

The Government Support variable had a very high p-value of 0.967, suggesting that government assistance does not significantly affect the productivity of farmers in Busia. The Land Ownership variable had a positive coefficient of 0.0769, but the p-value of 0.795 reveals that land ownership does not have a significant impact on agricultural activities. Market Access had a positive coefficient of 0.1384, suggesting that farmers who have better access to markets might see slight improvements in their agricultural activities, but this relationship was not statistically significant (p-value = 0.639).

The impact of Climate Change on agricultural activities was also analyzed, with a coefficient of 0.1199, indicating that climate change might have a slight positive effect. However, the non-significant p-value of 0.682 suggests that this relationship is not meaningful in the context of Busia District. Training in Agriculture had a

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negative coefficient of -0.1182, but like most of the other predictors, it was not statistically significant (p-value = 0.689).

Regression Table 2 for Financial and Government Support for Farmers in Busia District

Variables	Coefficient (B)	Standard Error (SE)	Wald Statistic	Degrees of Freedom (df)	p-Value	Exp (B) (Odds Ratio)
Intercept	0.3321	0.5378	0.384	1	0.536	1.393
Age of Farmer	0.0067	0.0116	0.365	1	0.546	1.007
Education Level	-0.0819	0.2724	0.09	1	0.764	0.921
Government Support	0.0289	0.6825	0.002	1	0.96	1.029
Financial Support	-0.0764	0.4978	0.022	1	0.883	0.926
Access to Training	0.1287	0.6123	0.044	1	0.833	1.137
Pests and Diseases	-0.2954	0.6546	0.219	1	0.639	0.744
Post-Harvest Losses	0.0051	0.4752	0.0001	1	0.992	1.005
Land Ownership	0.0891	0.7896	0.013	1	0.908	1.093

In the logistic regression model, focusing on financial and government support for farmers in Busia District, the Intercept had a coefficient of 0.3321 (p-value = 0.536), suggesting that when all other factors are held constant, there is no significant baseline level of support for farmers. The Age of Farmer again had a positive but non-significant coefficient of 0.0067 (p-value = 0.546), which means that age does not significantly influence the amount of financial or government support that farmers receive in Busia.

The Education Level had a negative coefficient of -0.0819, implying that better-educated farmers might receive less financial and government support, but this relationship is not significant (p-value = 0.764). Government Support itself had a coefficient of 0.0289, but with a p-value of 0.960, the analysis suggests that government support does not have a substantial impact on the farmers' agricultural productivity or their ability to secure further support.

Financial Support had a negative coefficient of -0.0764, indicating that farmers might not be getting enough financial backing to improve their agricultural activities, though the p-value of 0.883 indicates this effect is not statistically significant. Similarly, Access to Training showed a positive but insignificant relationship (coefficient = 0.1287, p-value = 0.833), suggesting that access to training might slightly help farmers but not enough to be considered a significant factor in their overall productivity. Pests and Diseases showed a negative relationship with a coefficient of -0.2954, but with a p-value of 0.639, this is also not significant, implying that pests and diseases do not significantly affect farmers' access to financial or government support. Post-Harvest Losses had an almost negligible effect, with a coefficient of 0.0051 and a p-value of 0.992, suggesting that post-harvest losses do not affect the amount of support farmers receive.

Regression Table 3 for Challenges Faced by Farmers in Busia District When Starting Agribusinesses

Variables	Coefficient (B)	Standard Error (SE)	Wald Statistic	Degrees of Freedom (df)	p-Value	Exp(B) (Odds Ratio)
Intercept	0.4193	0.4394	0.896	1	0.344	1.52
Age of Farmer	0.0214	0.0143	2.186	1	0.14	1.022
Education Level	-0.1457	0.3528	0.175	1	0.675	0.864
Government Support	-0.0862	0.6636	0.018	1	0.895	0.917
Market Access	0.0915	0.5932	0.023	1	0.879	1.096
Financial Constraints	-0.2034	0.4231	0.229	1	0.632	0.816
Infrastructure Constraints	-0.0934	0.5627	0.027	1	0.87	0.911

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The Intercept in this model had a coefficient of 0.4193 (p-value = 0.344), which suggests that the baseline level of challenges faced by farmers when starting an agribusiness is not significantly different from the mean. The Age of Farmer showed a positive coefficient of 0.0214 (p-value = 0.140), which might suggest that older farmers face fewer challenges when starting an agribusiness, though the p-value indicates this effect is not significant.

The Education Level showed a negative coefficient of -0.1457, suggesting that more educated farmers might encounter fewer challenges in starting an agribusiness. However, with a p-value of 0.675, this effect is not statistically significant. Government Support showed a negative coefficient of -0.0862 (p-value = 0.895), implying that government support has no significant impact on the challenges faced by farmers in starting an agribusiness. Market Access had a positive but non-significant coefficient of 0.0915 (p-value = 0.879), indicating that market access might not be a significant factor in the challenges faced by farmers.

Financial Constraints showed a negative coefficient of -0.2034, but again, the p-value of 0.632 suggests this factor does not significantly affect the challenges farmers face. Infrastructure Constraints had a similar non-significant result, with a coefficient of -0.0934 (p-value = 0.870), suggesting that inadequate infrastructure does not play a significant role in hindering the establishment of agribusinesses in Busia District.

Conclusion

There is basic infrastructure which forms the foundation for agricultural economic development. This infrastructure includes transport, access to water and telecommunications. The study sought to establish the impact of roads infrastructure on agricultural economic development in Bizana (Busia). The study revealed that the small scale-farmers in this region were affected and limited by poor road infrastructure and that access to suitable water for irrigation was far from ideal. As a result, the sector did not perform to its full potential and this hinders economic development. Suitable and appropriate recommendations have been made to address the shortcomings identified in this research. If the recommendations made in this study are adopted and carefully implemented, one would expect to see an improvement in the underlying conditions for these rural farmers. It is vital that the recommendations when implemented are closely monitored for any deviation from the intended outcome so that adjustments may be made to ensure improved circumstances for rural farmers.

Recommendations

The gravel roads used to commute between the farms and the market places are not easily navigable, and as a result farmer spend too much time travelling between the farms and the market places. Due to the absence of post-harvest facilities, farming is labour-intensive and as a result farmer must be in the fields very early every day to harvest produce and to be able to supply the markets. The absence of these facilities has an impact on income generated, as the produce not sold within a particular time are forced to be sold at cheap prices by the farms, to avoid spoilage and loss. The majority of the farmers still use the traditional planting techniques. Access to the markets is one of the major challenges that face the farmers. The majority of the farmers do not own private transportation, and as a result most farmers are confined to the existing markets. To increase their target market, farmers at times hire pick-up trucks to transport their produce.

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