

Impact of Banana Production on Smallholder Farmers' Livelihoods in Missenyi District, Tanzania

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Abstract

Banana farming plays a crucial role in ensuring food security and supporting the livelihoods of many farmers in developing countries. Therefore, this study explores the effects of banana production on the livelihood of smallholder farmers in Missenyi District, Bukoba, Tanzania. The study employed a cross-sectional research design to collect data from four villages: Bunazi, Nsunga, Kyaka, Mabuye and Kassambya. Additionally, Multiple Linear Regression models were used to estimate the effects of banana production on household income. The results show that factors such as gender, marital status, household size, capital investment, and market access significantly influence income from banana farming. These results suggest that improving access to markets and financial resources, as well as addressing gender disparities, can enhance the economic well-being of banana farmers in the region. The study recommends that targeted interventions, including the development of infrastructure, support for capital investment, and the promotion of gender equity, are essential for increasing productivity and income among smallholder banana farmers in Missenyi District.

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1. Introduction

Income from banana farming plays a crucial role in supporting households, particularly in tropical regions where bananas are a staple crop. As one of the most widely grown and consumed fruits globally, bananas provide essential food security and economic benefits to farming households (Merumba *et al.*, 2022). The income generated from agriculture is influenced by several factors, including yield, market prices, input costs, and the efficiency of resource utilization (Liu *et al.*, 2021; Kitole *et al.*, 2024; Kitole, 2023). Additionally, access to better markets and the adoption of advanced farming technologies can significantly boost household income from banana farming (Adoye *et al.*, 2019).

Despite the potential for high income from banana farming, small-scale farmers face numerous challenges that hinder productivity and profitability. These challenges include limited access to credit, quality inputs, and modern farming techniques, as well as poor infrastructure and market access (Lucas, 2021). In Missenyi District, Kagera Region, Tanzania, banana farming is a critical source of livelihood for many households. However, despite favorable growing conditions and a significant contribution to the region's banana output, Missenyi remains one of the poorest areas in the country, with high malnutrition rates and low economic indicators (NBS, 2022; Merumba *et al.*, 2022). This paradox highlights a critical research gap: understanding the determinants of household income from banana farming in this region and identifying ways to enhance productivity and profitability.

Moreover, banana farming in the Kagera Region faces additional challenges related to environmental degradation and climate variability. These factors contribute to fluctuations in banana yields, thereby affecting household income stability. The lack of access to reliable weather forecasts and the limited use of climate-resilient farming practices exacerbate the vulnerability of small-scale farmers to adverse weather conditions (Mina & Kumar, 2021). Addressing these environmental challenges through the adoption of sustainable farming practices and improved resource management is essential for stabilizing banana production and increasing income for farming households in Missenyi.

Furthermore, the traditional farming methods practiced by many banana farmers in Missenyi are often labour-intensive and less efficient compared to modern techniques. The limited adoption of agricultural innovations, such as improved banana varieties and mechanized farming tools, hampers productivity and income growth (Minch, 2017; Kitole *et al.*, 2024; Sharma *et al.*, 2021). Research has shown that the introduction of improved banana varieties, which are more resistant to pests and diseases, can significantly enhance yields and profitability (Kabunga *et al.*, 2012). However, the uptake of these innovations has been slow, primarily due to a lack of awareness, technical knowledge, and financial constraints.

In addition to these challenges, the market dynamics for bananas in Missenyi District are complex and often unfavourable for small-scale farmers. Fluctuations in market prices, coupled with the limited bargaining power of individual farmers, result in low-income margins. The absence of organized farmer groups or cooperatives further exacerbates this issue, as farmers lack the collective strength to negotiate better prices or access larger markets (Warinda *et al.*, 2020; Theodory & Kitole, 2024; Mmasa, 2022). Strengthening market linkages and promoting farmer cooperatives could play a significant role in improving income from banana farming by providing farmers with better access to markets and enhancing their bargaining power.

Lastly, the role of government policies and interventions in supporting banana farming in Missenyi cannot be overlooked. While there have been efforts to promote agricultural development in the region, such as through subsidies and extension services, these initiatives have often been insufficient or poorly implemented (Wahome *et al.*, 2021; Kitole *et al.*, 2023; Mmasa, 2022). The inconsistent availability of agricultural inputs, coupled with inadequate support services, has limited the effectiveness of these interventions. A more focused and sustained effort is needed to ensure that small-scale banana farmers in Missenyi receive the necessary support to overcome the challenges they face and to realize the full potential of their farming activities. This study seeks to address these issues by identifying the key determinants of household income from banana farming and providing recommendations for enhancing productivity and profitability in Missenyi District.

2. Theory underpinning

This study draws upon Production Theory, a cornerstone of microeconomic analysis, which focuses on how firms or producers transform inputs into outputs and how they optimize production decisions under various constraints. Production Theory provides a framework for understanding the processes and decisions involved in converting resources such as labor, capital, and land into goods or services. In the context of this study, Production Theory is applied to analyze the determinants of household income from banana farming in Missenyi District, Kagera Region.

Production Theory has been developed and refined over time by several key economists, including Adam Smith, David Ricardo, and Alfred Marshall. Adam Smith, often referred to as the father of economics, laid the groundwork for understanding the division of labor and the benefits of specialization in production. David Ricardo, building on Smith's ideas, introduced the concept of comparative advantage, which suggests that countries, regions, or producers should specialize in producing goods for which they have a lower opportunity cost compared to others. Ricardo's work emphasized the importance of resource allocation—particularly land, labor, and capital—as the key determinants of production efficiency and output.

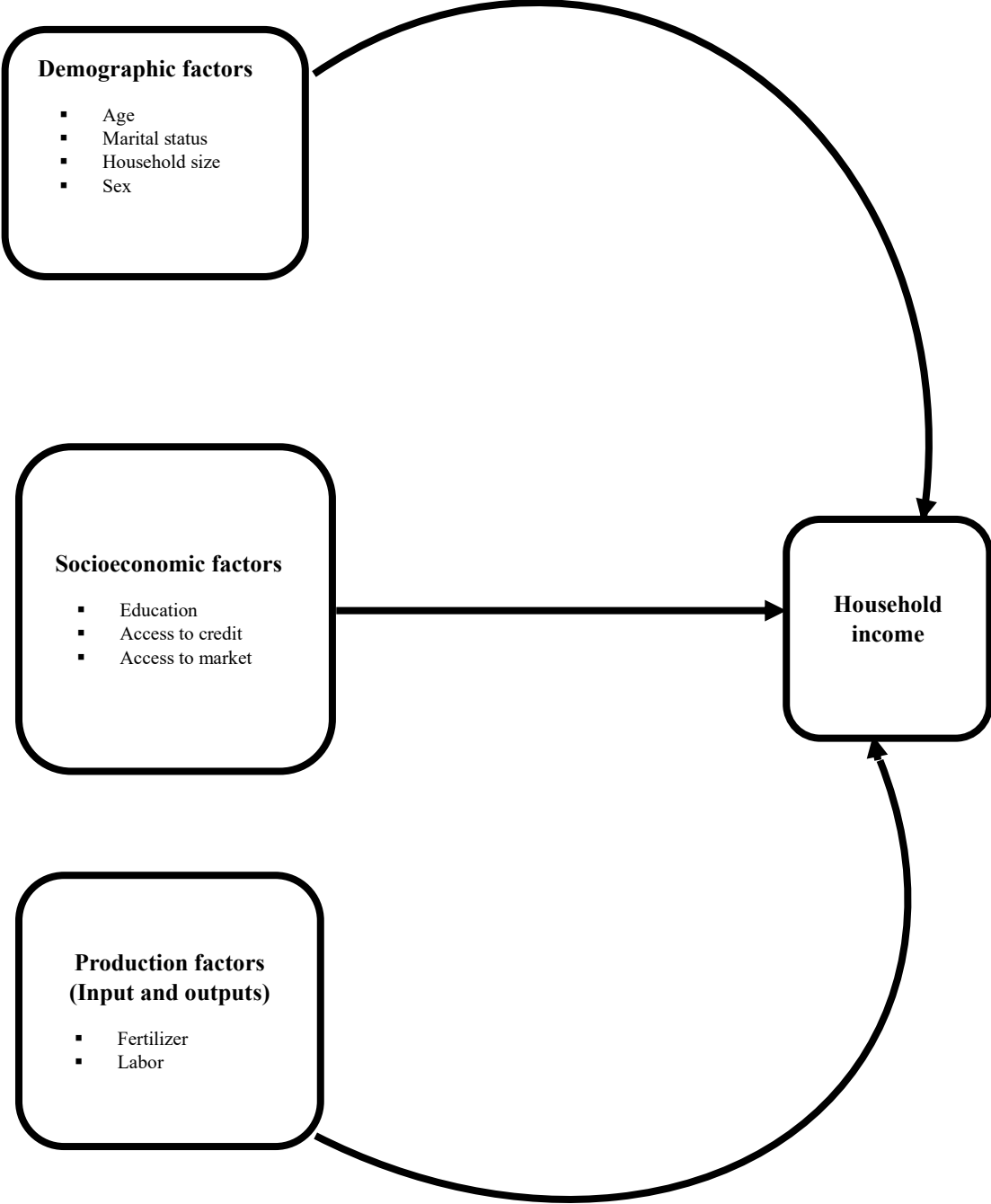
Alfred Marshall later expanded on these ideas by formalizing the relationship between inputs and outputs through the production function. Marshall's work emphasized the role of marginal analysis in understanding how changes in input levels affect output and, consequently, income. The production function, often represented in its simplest form as the Cobb-Douglas production function, expresses output as a function of the quantities of inputs used, typically labor and capital. This function is particularly useful in agricultural economics for assessing the efficiency and productivity of various crops, including bananas.

Production Theory aligns closely with the objectives of this study, as it offers a robust framework for analysing the economic factors that influence household income from banana farming. By applying the principles of Production Theory, this study seeks to identify and measure the key determinants of productivity and profitability in banana farming, such as labor input, capital investment, production costs, and access to markets. Understanding these factors is crucial for optimizing resource allocation and improving the economic outcomes for small-scale farmers in Missenyi District.

Furthermore, the relevance of Production Theory to this study is reinforced by its application in previous agricultural research. For instance, it has been used to evaluate the role of agronomic practices in banana farming, assess the impact of socio-economic factors on agricultural productivity, and analyze production costs and outputs in various crop systems. By drawing on this theoretical framework, the study aims to provide insights into how small-scale farmers in

Missenyi can enhance their production efficiency and increase their household income through improved resource management and strategic decision-making.

Figure 1 Conceptual framework



Source: Author’s conceptualization (2024)

3. Methods and materials

This study was conducted in three wards within Missenyi District, Kagera Region, Tanzania: Kassambya, Nsunga, and Kyaka, covering the villages of Bunazi, Nsunga, Kyaka, Mabuye, and Kassambya. Missenyi District, with a population of approximately 245,394 people and an area of 1,425 square kilometres, is primarily agricultural, with key activities including farming, livestock rearing, fishing, and trade (National Bureau of Statistics (NBS), 2022). The district's economic importance is reflected in its high per capita GDP and the presence of three banks (NMB, NBC, and CRDB) in Bunazi, the district headquarters (Stanslaus *et al.*, 2021).

A cross-sectional research design was employed to collect data from a representative sample of smallholder banana farmers in Missenyi District at a single point in time. Stratified sampling was used to ensure a comprehensive analysis of the various factors affecting household income from banana farming (Dimoso & Andrew, 2021). Data were gathered from the agricultural office, local farmers, and a field survey conducted in the selected villages. These villages were chosen due to their high concentration of smallholder farmers, making them ideal for studying the determinants of income in banana farming households.

Moreover, in this study, a total of 100 respondents were selected as the sample, representing households involved in banana farming in Missenyi District. The sample size was carefully determined to ensure that it was neither too large nor too small, aligning with the guidelines for efficiency, representativeness, dependability, and adaptability (Creswell, 2014; Cohen *et al.*, 2018). The sample size was calculated based on the total population of 97,919 households in the four selected wards within the district. To determine the appropriate sample size, the study employed the sample size formula proposed by Yamane (1967), which accounts for a margin of error of 10%. As a result, 100 households were deemed sufficient to provide a representative sample for the study, ensuring that the findings would be both reliable and applicable to the broader population in Missenyi District.

3.1 Analytical model

The Cobb-Douglas production function is a widely recognized model in economics, known for its simplicity and ability to represent the relationship between inputs and outputs in a production process. It is a homogeneous function of degree one, meaning that if the inputs are scaled by a certain factor, the output will scale by the same factor (Henderson & Richard, 1980). This characteristic makes it particularly useful for analysing production efficiency, where the proportionality between input changes and output is critical. Although many production functions are curvilinear in nature (Mafoso, 1999), the Cobb-Douglas function offers a straightforward and effective way to examine how different factors contribute to production.

In this study, the Cobb-Douglas production function is utilized to assess the impact of various inputs on banana production income. The function is represented as:

$$Y = \alpha L^{\beta_1} K^{\beta_2} O^{\beta_3} M^{\beta_4} I^{\beta_5}$$

Whereas Y is Total income from banana farming (dependent variable), L is Labour input (amount of labour employed), K is Amount of capital invested, O is Total output from banana farming, M

is Market access, I is input cost, α is the constant term, and β_1, \dots, β_5 are the coefficients of the respective independent variables. The general regression equation for the study is given as:

$$\log(Y) = \log(\alpha) + \beta_1 \log(L) + \beta_2 \log(K) + \beta_3 \log(O) + \beta_4 \log(M) + \beta_5 \log(I) + \mu$$

The use of the Cobb-Douglas production function in this study is justified by its simplicity and effectiveness in capturing the relationships between key factors influencing banana production. By specifying this functional relationship, the study aims to quantify the impact of labor, capital, output, market access, and input costs on the income generated from banana farming, providing valuable insights into the determinants of productivity and efficiency in this agricultural context. Moreover, description and measurement of variables used in the study has been presented at Table 1.

Table 1 descriptive variables and relationship

Variables	Type of variable	Measurement	Expected relationship
Total income from banana farming	Continuous variable	Total income earned monthly	Positive (+)
Labour input	Continuous variable	Amount of labour employed	Positive (+)
Capital invested	Continuous variable	Amount of capital invested	Positive (+)
Total output from banana farming	Continuous variable	Number of banana bunches	Positive (+)
Market access	Continuous variable	Number of markets accessed	Positive (+)
Input cost	Continuous variable	Amount of cost incurred	Positive (+)

Figure 2: Banana farm in one of the villages in Missenyi district, Bukoba region.



Source: Field data (2024)

4. Results

The results presented in Table 2 provide a comprehensive description of the smallholder banana producers in Missenyi District. The gender distribution of respondents shows that a significant majority, 75%, are male, while the remaining 25% are female. This indicates that banana farming in the district is predominantly undertaken by men. In terms of marital status, 61% of the respondents are married, while 39% are single. This suggests that a considerable portion of banana farmers are likely to be in family units, which may influence household labor dynamics and decision-making in farming activities.

Regarding household size, the distribution reveals that the most common household size among the respondents is between 4 to 6 members, accounting for 37% of the total. This is closely followed by households with 7 to 10 members, which make up 35%. Smaller households with 0 to 3 members represent 18%, while larger households with 11 or more members constitute 10%. These variations in household size may have implications for the availability of labor for farming activities and the overall productivity of banana farming in the district. The location distribution of the respondents across villages shows that Kassambya has the highest representation, with 38% of the farmers residing there. The other villages—Bunazi, Nsunga, Mabuye, and Kyaka—each have 15% to 17% of the respondents. This spread suggests that banana farming is relatively widespread across different areas in Missenyi District, with Kassambya being a particularly significant hub for this agricultural activity.

Table 2: Description of smallholder banana producers in Missenyi district

Variables	Attributes	Number of respondents	Percentage
Sex	Male	75	75.00%
	Female	25	25.00%
	Total	100	100.00%
Marital status	Married	61	61.00%
	Single	39	39.00%
	Total	100	100.00%
Household size	0-3 members	18	18.00%
	4-6 members	37	37.00%
	7 – 10 members	35	35.00%
	11 and above members	10	10.00%
	Total	100	100.00%
Location/Village	Kassambya	38	38.00%
	Bunazi	15	15.00%
	Nsunga	17	17.00%
	Mabuye	15	15.00%
	Kyaka	15	15.00%
	Total	100	100.00%

Source: Field data (2024)

The results in Table 3 provide a detailed description of the inputs and outputs among smallholder banana producers in Missenyi District. The average monthly income from banana crops is reported at TZS 124,525, with a standard deviation of TZS 74,228.94. This indicates a wide variation in income among farmers, with some earning as little as TZS 10,000 and others as much as TZS 300,000 per month. This disparity suggests differences in productivity, market access, or other factors influencing banana farming success.

Table 3 Description of the inputs an output across smallholder banana producers

Variable	Observation	Mean	Std.	Minimum	Maximum
Income from banana crop monthly	100	124525	74228.94	10000	300000
Number of labours employed	100	2.54	1.702167	1	9
Input cost	100	69670	55590.32	10000	300000
Capital	100	247700	362515.4	30000	2000000
Output (number of bunches)	100	36.71	24.48966	5	200
Number of markets accessed	100	1.89	1.153782	1	5

Source: Field data (2024)

On average, farmers employ approximately 2.54 labourers, with a standard deviation of 1.70, reflecting a range of labor use from as few as 1 to as many as 9 labourers. This variation in labor

employment could be related to differences in farm size, household size, or the financial capacity of the farmers. Moreover, the input cost for banana farming averages TZS 69,670, with a standard deviation of TZS 55,590.32, indicating significant variability in how much farmers spend on inputs. The costs range from a minimum of TZS 10,000 to a maximum of TZS 300,000, reflecting differences in farming practices, scale of operations, or access to resources.

The average capital investment is TZS 247,700, but with a large standard deviation of TZS 362,515.4. This suggests substantial variation in capital investment among farmers, with some investing as little as TZS 30,000, while others invest up to TZS 2,000,000. This wide range points to differences in financial capacity and the scale of farming operations.

In terms of output, the average number of banana bunches produced is 36.71, with a standard deviation of 24.49. The number of bunches ranges from 5 to 200, indicating a significant variation in productivity among farmers, which could be due to differences in farming techniques, input use, or environmental factors. Finally, the number of markets accessed by farmers averages 1.89, with a standard deviation of 1.15. The range is from 1 to 5 markets, suggesting that while some farmers have access to multiple markets, most operate with access to one or two, which could affect their income and market reach.

4.1 To determine factors affecting household income from banana farming in Missenyi district

The results presented in Table 4 provide an analysis of the effects of banana production on the livelihoods of smallholder farmers, as reflected in their household income. The model shows a statistically significant relationship between several variables and household income, with an R-squared value of 0.6305, indicating that approximately 63.05% of the variation in household income can be explained by the independent variables included in the model.

Table 4: Effects of the banana production on the smallholder farmers livelihood

Household income	Coefficient	Robust standard error	t	P>t	95% Confidence Interval		
Sex (Male)	0.208841	0.004611	5.02	0.002	0.004523	1.984143	
Marital status (Married)	0.370041	0.095101	2.03	0.016	0.018872	1.093117	
Household size	0-3 members	0.051601	0.012281	2.17	0.010	-0.004261	0.377430
	4-6 members	0.170041	0.010882	2.98	0.024	0.160994	1.003132
	7-10 members	0.094431	0.004102	4.56	0.000	0.030241	0.46638
	More than 11	0.046881	0.040331	0.35	0.184	0.00853	1.28803
Number of labours employed	-0.956150	5.179021	-0.11	0.270	-1.119231	0.400671	
Input cost	0.239847	0.254311	0.94	0.348	-0.265091	0.744788	
Capital	0.186088	0.024600	3.50	0.001	0.037244	0.134933	
Output number of bunches	0.218715	0.011890	4.61	0.000	0.014179	1.900562	
Number of markets	0.428801	0.050471	6.59	0.008	0.004531	1.420336	
Constant	0.351383	0.026112	4.43	0.018	0.273855	1.999760	
Model strength	Number of obs	=	100				
	F (5, 94)	=	21.25				
	Prob > F	=	0.0000				
	R-squared	=	0.6305				
	Adj R-squared	=	0.5056				

Source: Field data (2024)

Gender plays a significant role in determining household income, with male farmers having a positive coefficient of 0.208841, which is statistically significant at the 0.002 level ($p = 0.002$). This suggests that male farmers, on average, earn higher incomes from banana production compared to their female counterparts, with a 95% confidence interval ranging from 0.004523 to 1.984143. Additionally, marital status also significantly influences household income, with married farmers showing a positive coefficient of 0.370041, significant at the 0.016 level ($p = 0.016$). This indicates that being married is associated with higher household income, with a confidence interval of 0.018872 to 1.093117, suggesting that marital status may contribute to stability and potentially more labor availability within the household.

Household size has a varied impact on income, with households having 0-3 members, 4-6 members, and 7-10 members all showing positive coefficients of 0.051601, 0.170041, and 0.094431 respectively. The coefficient for households with 4-6 members is significant at the 0.024 level ($p = 0.024$), while the coefficient for households with 7-10 members is highly significant at the 0.000 level ($p = 0.000$). This suggests that larger households, particularly those with 4-10 members, may benefit from increased income due to potentially greater labor availability. However, households with more than 11 members do not show a significant effect on income, as indicated by the non-significant coefficient of 0.046881 ($p = 0.184$).

The number of labourers employed has a negative coefficient of -0.956150, though this result is not statistically significant ($p = 0.270$), indicating that the number of labourers does not have a clear impact on household income in this context. Input costs also do not show a significant

relationship with income, with a coefficient of 0.239847 and a p-value of 0.348. In addition, capital investment and output, however, are both significant predictors of income. The coefficient for capital is 0.186088, significant at the 0.001 level ($p = 0.001$), indicating that higher capital investment is associated with higher household income. The output, measured by the number of banana bunches produced, also has a positive and significant coefficient of 0.218715 ($p = 0.000$), demonstrating that higher output directly correlates with increased income.

Finally, access to markets shows the strongest positive effect on income, with a coefficient of 0.428801, significant at the 0.008 level ($p = 0.008$). This underscores the importance of market access in enhancing household income from banana production, as greater access to markets likely provides better opportunities for selling produce at favorable prices. Overall, the analysis reveals that gender, marital status, household size, capital, output, and market access are key determinants of household income from banana farming in Missenyi District, with market access and output showing the most substantial effects.

5. Discussion

The findings from this study reveal significant insights into the factors that influence household income among smallholder banana farmers in Missenyi District. The results indicate that several socio-economic variables, including gender, marital status, household size, capital investment, output, and market access, play critical roles in determining the income levels of these farmers.

One of the most striking findings is the positive and significant effect of gender on household income, with male farmers earning more than their female counterparts. This result may be reflective of the broader socio-economic dynamics in rural Tanzania, where male farmers often have better access to resources, capital, and markets compared to female farmers. This gender disparity in income is consistent with previous studies that highlight the challenges women face in accessing agricultural inputs and services, which in turn limits their productivity and income potential (Suresh *et al.*, 2021). The implication of this finding suggests a need for targeted interventions that address gender disparities in agricultural resource allocation and market access to ensure equitable income distribution among male and female farmers.

Marital status also emerged as a significant determinant of household income, with married farmers showing higher income levels than their single counterparts. This could be attributed to the additional labor and support that marriage often brings, such as shared responsibilities and joint decision-making, which can lead to more efficient farm management and higher productivity. Moreover, married farmers may have better access to social networks and community support, which can facilitate access to markets and credit (Teklu & Shimelis, 2022). However, it is essential to note that while marriage can be an advantage, it also places additional financial burdens on households, which may affect their overall economic stability (Teklu *et al.*, 2021).

Household size presents an interesting dynamic in its relationship with income. The findings suggest that households with 4-10 members benefit from increased income, likely due to the availability of more labor to contribute to farming activities. Larger households may have more hands to work on the farm, thereby increasing productivity and income. However, the results also indicate that households with more than 11 members do not experience a significant increase in income. This may be due to the fact that very large households have higher consumption needs, which could offset the income gains from additional labor (Kitole *et al.*, 2023; Kitole *et al.*, 2024).

This finding aligns with previous research that suggests an optimal household size for agricultural productivity, beyond which the benefits of additional labor diminish (Tesfay, 2020).

Capital investment and output are two of the most critical factors influencing household income. The positive and significant relationship between capital and income underscores the importance of financial resources in enhancing productivity and profitability in banana farming. Farmers who can invest more in their farms, whether through purchasing better inputs, hiring labor, or expanding their operations, are likely to achieve higher yields and, consequently, higher incomes (Kitole *et al.*, 2024). Similarly, the strong positive impact of output on income highlights the direct correlation between productivity and economic gains. Farmers who produce more banana bunches are able to sell more, thereby increasing their household income. This finding is consistent with the general economic principle that higher output leads to higher revenue, particularly in agricultural settings where market demand is high (Merumba *et al.*, 2022).

Market access is identified as the most significant factor influencing income among the farmers in this study. The ability to access multiple markets allows farmers to find better prices for their produce, reduce transaction costs, and increase their bargaining power. This result emphasizes the importance of infrastructure development, such as roads and transportation services, as well as the need for market information systems that can help farmers make informed decisions about where and when to sell their products (Adeoye *et al.*, 2019). It also highlights the potential benefits of forming cooperatives or farmer groups, which can enhance market access and improve income distribution among smallholder farmers (Lucas, 2021; Amankwah *et al.*, 2018).

However, the findings also show that certain variables, such as the number of labourers employed and input costs, do not have a significant impact on income. This could suggest that simply increasing the number of workers or spending more on inputs does not necessarily translate into higher income. Instead, it points to the importance of efficient resource use and the need for farmers to optimize their labor and input management to achieve better productivity and income outcomes (Mina & Kumar, 2021). This aligns with studies that emphasize the importance of resource efficiency over sheer quantity in agricultural production (Minch, 2017).

Therefore, this study provides valuable insights into the determinants of household income among smallholder banana farmers in Missenyi District. The findings highlight the critical roles of gender, marital status, household size, capital investment, output, and market access in shaping economic outcomes for these farmers. To improve the livelihoods of smallholder banana farmers, policy interventions should focus on addressing gender disparities, enhancing capital access, improving market infrastructure, and promoting efficient resource use. Such measures are essential for achieving sustainable income growth and reducing poverty among smallholder farmers in the region (Warinda *et al.*, 2020).

6. Conclusion and recommendation

The findings of this study underscore the importance of various socio-economic factors in shaping household income among smallholder banana farmers in Missenyi District, Tanzania. Key determinants such as gender, marital status, household size, capital investment, output, and market access have been identified as critical to improving income levels. Market access and capital investment emerged as the most significant drivers of income, highlighting the need for enhanced infrastructure and financial support to boost productivity and profitability in banana farming. The

study also reveals the existence of gender disparities in income, suggesting that targeted interventions are necessary to ensure equitable access to resources and opportunities. Additionally, the impact of household size on income emphasizes the need for efficient labor management within farming households.

Given these findings, several recommendations can be made to improve the livelihoods of smallholder farmers in the region. First, there is a pressing need to enhance market access for farmers by improving infrastructure, such as roads and transportation networks, which would facilitate better access to markets and enable farmers to sell their produce at more favorable prices. Establishing market information systems that provide real-time data on prices and demand would further empower farmers to make informed decisions, thereby increasing their income potential. Addressing gender disparities is also crucial, and this can be achieved by providing women with better access to resources, training, and financial services, as well as promoting their participation in decision-making processes within agricultural households and cooperatives.

Support for capital investment should also be strengthened, with financial institutions and government programs offering affordable credit options, such as low-interest loans or subsidies for agricultural inputs and capital investments. This would enable farmers to enhance their productivity and income by making necessary investments in their farming operations. Additionally, optimizing household labor is essential, and this can be achieved through extension services that educate farmers on efficient labor management practices. By training farmers on how to allocate labor effectively within households, particularly in larger families, productivity can be maximized without overburdening individual members.

Encouraging the formation of farmer cooperatives or groups could further enhance collective bargaining power, improve market access, and reduce transaction costs for smallholder farmers. Cooperative models can also facilitate access to shared resources and training, further improving productivity and income levels. Lastly, strengthening agricultural support services is vital to ensure that all smallholder farmers, regardless of their location or household size, have access to the latest farming techniques, input recommendations, and market trends. By implementing these recommendations, the economic well-being of smallholder banana farmers in Missenyi District can be significantly enhanced, leading to greater income stability and reduced poverty in the region.

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