Effects of Coffee Production on Household Income among Smallholder Farmers in Mbinga District, Tanzania

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ARTICLE INFO	ABSTRACT
Keywords Coffee production Smallholder farmers Household income Mbinga District	*Coffee production plays a crucial role in supporting rural livelihoods and the Tanzanian economy by generating income, creating jobs, and boosting export earnings. Despite its importance, smallholder coffee farmers continue to face challenges, including low productivity, volatile prices, and limited access to markets and inputs. However, its effects on household income are not explicit. This study thus examined the effects of coffee production on household income among smallholder farmers in the Mbinga District. A cross-sectional research design was employed, and data were collected from 327 smallholder farmers through structured questionnaires and interviews with key informants. Both descriptive and inferential statistics, specifically the chi-square test, were used to examine the association between coffee production and smallholder farmers' income levels. The results revealed that the income from coffee production (mean TZS 3,695,069.11) was significantly higher than the income from other sources (mean TZS 1,542,350.75), demonstrating that coffee production is the main livelihood activity for smallholder farmers. Moreover, the number of coffee trees, years of experience, input use, yield, and market price were significantly associated with income level ($p < 0.05$). The study concludes that although coffee production substantially enhances household income, disparities persist because of differences in access to resources, farm size, and productivity. These findings underscore the importance of improving coffee production inputs, extension services, and market access to strengthen coffee farmers' economic resilience and ensure sustainable rural livelihoods.*

1. Introduction

Coffee is one of the most valuable agricultural commodities worldwide, with an estimated 167.2 million 60 kg bags produced in 2023 (ICO, 2023). It is cultivated in almost 70 countries, with Brazil, Vietnam, and Colombia being the largest producers. The coffee industry supports the livelihoods of nearly 125 million people globally, including 25 million smallholder farmers who rely on coffee as their primary source of income (Bray and Neilson, 2019). Smallholder farmers are those who operate on less than 10 hectares of land, mainly using family labour and traditional farming methods, and often face constraints such as limited access to markets, financing, and modern agricultural technologies (FAO, 2021). Coffee production is a crucial driver of economic growth, employment, and foreign exchange earnings in many developing countries. It contributes over $30 billion annually in global exports. Still, smallholder farmers receive less than 10% of the final retail price, largely due to market inefficiencies and the dominance of multinational corporations in the value chain (ICO, 2023).

The top 10 coffee-producing countries account for nearly 90% of the world's coffee supply (United States Department of Agriculture & Foreign Agricultural Service, 2024). Brazil leads as the largest producer, accounting for about 3.98 million tonnes (38% of global production), followed by Vietnam with 1.81 million tonnes (17%) and Colombia with 774,000 tonnes (7%) (ICO, 2023; Ngure & Watanabe, 2024). Other significant producers include Indonesia with 10.9 million tonnes (6%), India with 6.2 million tonnes (4%), Honduras with 5.3 million tonnes (3%), Peru with 4.35 million tonnes (2%), and Mexico with 3.87 million tonnes (2%). Brazil primarily produces Arabica coffee, while Vietnam specializes in Robusta. Together, Brazil and Vietnam produce more than half of the world's coffee annually (Ngure & Watanabe, 2024).

Africa accounts for approximately 12% of global coffee production, while Ethiopia, with 8.36 million tonnes (5%), and Uganda, with 6.4 million tonnes (4%), are the largest producers (ICO, 2023; Ngure & Watanabe, 2024). Other significant coffee-growing countries include Tanzania, Kenya,

Rwanda, and Côte d'Ivoire (ICO, 2023). Despite this potential, the continent faces substantial production-related challenges. Average yields are low, with African coffee farms producing around 450-500 kg per hectare, compared to over 2,000 kg per hectare in countries like Brazil and Vietnam (Bermudez et al., 2022; United States Department of Agriculture & Foreign Agricultural Service, 2024). Climate change has further reduced productivity, as rising temperatures and erratic rainfall have led to yield declines of 10-20% in Ethiopia and 25% in East Africa (Abebaw, 2025). Projections suggest that by 2050, up to 50% of current coffee-growing areas may become unsuitable due to rising temperatures, erratic rainfall, increased pest and disease prevalence, soil degradation, and the upward shift of suitable altitudes caused by climate change (Bunn *et al.,* 2015). These production problems directly affect how much farmers earn. Moreover, international price fluctuations undermine income stability and hinder reinvestment in farm improvements. Coffee contributes significantly to rural livelihoods and national economies, but the volatility of returns has left many dependent farmers vulnerable. Smallholder farmers, in particular, struggle with limited access to modern inputs, credit, and extension services, making it difficult for them to adopt climate-resilient practices (Bracken *et al.,* 2021).

Despite these challenges, several regional initiatives have been implemented to support smallholder coffee farmers in Africa. The African Coffee Sector Development Strategy (ACDS) aims to improve coffee productivity, enhance value addition, and ensure fair market access for farmers. Furthermore, fair trade and certification programs such as UTZ and the Rainforest Alliance have helped farmers secure better prices and improve sustainability practices (FAO, 2021). Government and private sector partnerships, particularly in Ethiopia and Rwanda, have provided smallholder farmers with access to better training, improved inputs, and credit facilities. However, much remains to be done to enhance the resilience of African coffee farmers and ensure that they receive fair compensation for their contributions to the global coffee supply chain (Lelisa and Genemo, 2020).

In Tanzania, coffee is one of the key agricultural export products, accounting for around 5% of total exports and 24% of traditional cash crop exports. For the past three decades, it has consistently earned the country an average of 100 million USD in export revenues each year (Lupondo *et al.,* 2025). Tanzania's coffee production has shown a consistent upward trend, with an average annual output of 73,206 tons, up from a baseline estimate of 43,288 tonnes. The lowest recorded production was 32,489

tonnes in the 2003/04 season, while the highest output reached 73,027.01 tonnes in the 2020/21 season (TanzaniaInvest, 2024). Coffee accounts for approximately 24% of Tanzania's total agricultural exports, making it a crucial foreign-exchange earner (Lupondo *et al.,* 2025). The sector directly employs over 400,000 smallholder farmers and indirectly supports the livelihoods of more than 2.4 million people, primarily in rural areas (Dogeje *et al.,* 2024). The country mainly grows two varieties: Arabica, which accounts for 70% of production, and Robusta, which accounts for the remaining 30% (Lyimo & Zaharani, 2021). According to the Tanzania Coffee Board 2022 annual report (TCB), Tanzanian coffee exports for the 2021/22 season were projected to reach 66.5 million kilograms, generating approximately USD 204 million in revenue. Tanzania is increasingly recognized as a prominent coffee producer, with coffee ranking as the second-largest traditional commodity in the country (Herrmann *et al*., 2018; Li *et al*., 2023). The agricultural sector, which encompasses coffee, accounts for approximately 30% of Tanzania's GDP and provides employment for 65% of the population (Isgren *et al.,* 2020). In the Mbinga District, coffee farming serves as a primary source of income for numerous smallholder farmers, thereby influencing household economic stability and contributing to national export revenues (Guo *et al.,* 2023). However, climate change is increasingly jeopardizing this contribution. Projected increases in temperature and a vapour pressure deficit pose specific threats to Arabica coffee production in the Mbinga District (Chegere & Kauky, 2022). Coffee production in this area significantly contributes to the local economy and livelihoods despite facing substantial challenges, including those posed by climate change (Chegere & Kauky, 2022; Liu *et al*., 2024; Silvano & Jespersen, 2025). Smallholder farmers in the northern and southern highlands of Tanzania, including those in Mbinga, are particularly vulnerable to climate-related impacts. Other challenges include structural and operational issues, including low productivity (250-300 kg per hectare), limited extension services, high production costs, soil infertility, and low fertilizer use. Smallholder farmers continue to cultivate coffee without a clear contribution from this crop to their income (Mhando and Ntengua, 2018). Other issues, such as pest and disease attacks, drought, poor agronomic practices, and old coffee trees, further reduce yields (Otieno *et al.,* 2019). In addition, limited access to credit prevents farmers from investing in improved seedlings and irrigation systems (Bhat and Velmourougane, 2020).

Recognizing the significance of coffee in national development, the Tanzanian government has

implemented several policies and initiatives to improve coffee production and marketing. The Tanzania Coffee Board (TCB) regulates and oversees quality control in the sector, ensuring adherence to international standards. The National Coffee Development Strategy (NCDS) 2011-2021 was introduced to enhance productivity, value addition, and export competitiveness. In addition, financial institutions such as the Tanzania Agricultural Development Bank (TADB) have provided loans to smallholder farmers to invest in improved farming technologies (Ngambila *et al.,* 2024). Studies on coffee production and its factors highlight the effects of market reforms, pricing challenges, and broader industry factors. For instance, factors affecting smallholder coffee farmers include price volatility after the collapse of the International Coffee Agreement (Mkandya *et al.,* 2010), climate change impacts on Coffea arabica and Coffea canephora (Bunn *et al.,* 2015), and structural challenges like ageing trees, soil degradation, pests, and poor agronomic practices (Otieno *et al.*, 2019). However, these studies did not examine how these challenges directly affect household-level socio-economic well-being and livelihood strategies.

Africa, including Tanzania, plays a significant role in global coffee production, with smallholder farmers deeply embedded in agricultural markets and commercialization. These farmers, particularly in countries such as Tanzania, rely on coffee production as a key economic activity that boosts household income and enhances food security. Despite this, the precise contribution of coffee farming to household income remains underexplored and somewhat implicit in the existing literature. Recent studies have shifted the focus to understanding broader agricultural market dynamics, emphasizing the importance of value chain linkages and their influence on food security outcomes. For instance, Herrmann *et al.* (2018) analyzed the status and drivers of market linkages among Tanzanian farmers, highlighting how these connections affect agricultural income and household food security in Tanzania. Chegere and Kauky (2022) delve into the relationship between agricultural commercialization, dietary diversity, and nutritional status in Tanzania, utilizing data from the National Panel Survey. Their findings underscore the complexity of how market integration through crops such as coffee can influence not only economic well-being but also nutritional outcomes. Together, these studies illustrate an evolving understanding of the multifaceted impact of agricultural commercialisation on rural livelihoods. Therefore, this study seeks to examine the effects of coffee production on the household incomes of smallholder farmers in Myangayanga ward, Mbinga district.

2. Materials and Methods
2.1. Study Area and Research Design

This study was conducted in Myangayanga Ward, Mbinga District, Ruvuma Region, southern Tanzania. This district is bordered to the north by the Njombe Region, to the east by Songea Rural and Songea Urban Districts, to the south by Mozambique, and to the west by Lake Nyasa. The district's annual rainfall ranges from 1,200 mm to 1,500 mm, and the temperatures vary between 13°C in the highlands and 30°C near the lake shore. The selection of Myangayanga Ward was purposive, based on its location within Mbinga District, a major producer of high-quality Arabica coffee that contributes approximately 25% of Tanzania's total Arabica coffee production (TACRI, 2024). In addition, Myangayanga Ward hosts a high concentration of smallholder coffee farmers and exhibits production and marketing characteristics that are representative of coffee-dependent wards in the district. With over 50,000 smallholder farmers engaged in cultivation, coffee farming formed the backbone of the local economy, significantly supporting household incomes and rural development. Approximately 42,000 smallholders cultivated 32,000 hectares, accounting for about 70% of the district's economy.

This study adopted a cross-sectional research design, which involved collecting data at a single point in time to examine existing conditions, relationships, and practices among smallholder coffee farmers. The cross-sectional approach was suitable for this study because it allowed a comprehensive assessment of how variations in coffee production correlated with socio-economic outcomes, including income, farm size, farm inputs, and income earned.

2.2. Sampling and data collection
2.2.1. Sampling Procedure

The study population comprised smallholder coffee farming households in Myangayanga Ward, Mbinga District. The unit of analysis was the household, while the level of analysis was ward-level, with all sampled households drawn exclusively from Myangayanga Ward. The sampling frame was a list of registered coffee farmers at the ward level, obtained from district-level agricultural offices and cooperative societies. Using this sampling frame, systematic random sampling was employed to select household respondents. The sampling interval was determined by dividing the total number of registered coffee farmers in the ward by the required sample size. The sample size of 327 smallholder

coffee farmers was determined using Yamane's (1967) sample size formula for a known population at a 95% confidence level and a 5% margin of error: In addition, purposive sampling was used to select 14 key informants, comprising ten (10) cooperative leaders, two (2) agricultural extension officers, one (1) Ward Executive Officer (WEO), and one (1) District Agricultural Officer. These key informants were selected because they possess technical, institutional, and market-related knowledge relevant to coffee production, marketing systems, and farmer support services, which could not be adequately obtained from household respondents.

$$n = \frac{N}{1 + N(e)^2} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . (i)$$

where:

n = sample size, N = total number of registered smallholder coffee farmers in Myangayanga Ward (1,779), and e = margin of error (0.05)

$$n = \frac{1779}{1 + 1779(0.05)^2}$$

2.2.2. Data Collection Methods

Primary data were collected through face-to-face interviews with smallholder coffee farmers, using a structured questionnaire. The questionnaire captured quantitative information on socio-demographic characteristics, coffee production practices, yields, prices, marketing channels, and household income from coffee and other livelihood sources. In addition, key informant interviews were conducted using a semi-structured guide to obtain contextual and explanatory information on coffee production challenges, cooperative performance, market pricing, extension services, and institutional support at ward and district levels. These qualitative data were used to complement and interpret the quantitative survey findings.

2.3. Data Analysis

Quantitative data were analyzed using IBM SPSS Statistics, version 27. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise respondents' socio-demographic characteristics, coffee production variables, and household income levels. Inferential analysis was conducted using the Chi-square (χ^2) test of independence to examine the association between coffee production characteristics and household income categories. The model is expressed as:

$$\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots ..(ii)$$

where O_{ij} denotes the observed frequency and E_{ij} the expected frequency. Statistical significance was assessed at the 1% and 5% levels, and the results are presented in the Results and Discussion section. Qualitative data from key informant interviews were analysed using content analysis to identify themes that complemented the quantitative findings.

3. Results and Discussion
3.1. Demographic Characteristics of Respondents
3.1.1. Age of the Respondents

Results in Table 1 showed that 40.4% of respondents were aged 50 years or older, followed by 23.9% aged 41-50 years and 16.2% aged 20-30 years, indicating that coffee farming in Myangayanga Ward is dominated by farmers aged 50 years or older. Farmers aged 50 or older typically own farms and settle in rural areas to engage in production activities. The findings of this study are also reflected in the work of Mapunda et al. (2018), who reported that older farmers in the Mbinga District engaged more in coffee production due to their long-term experience. However, Ngambila *et al.* (2024) showed that middle-aged farmers were more active in Rungwe and Mbeya, partly due to interventions attracting youth to coffee farming. Similarly, Wambua *et al.* (2021) found that middle-aged farmers in Kenya were more productive because they readily adopted modern technologies compared with older farmers. These comparisons suggest that while older farmers sustain coffee farming in the Myangayanga ward, limited youth participation may challenge the sustainability of future production.

3.1.2. Sex of the Respondents

Results in Table 1 indicated that 87.2% of respondents were male and 12.8% were female, indicating that coffee farming in the study area is male-dominated. This aligns with Mapunda *et al.* (2018), who found that men were more engaged in coffee marketing and production in the Mbinga district than women due to traditional practices that limit women's access to and ownership of land. Ngambila *et al.* (2024) reported similar sex disparities in Rungwe and Mbeya, with women's participation remaining low despite interventions. These disparities stem from socio-cultural norms that limit their access to land, credit, and training. Wambua *et al.* (2021) pointed out that gender imbalances influence productivity and technology adoption, potentially reducing household livelihood outcomes.

3.1.3. Education level of respondents

Results in Table 1 showed that (78.3 %) smallholder coffee farmers had primary education, and few (2.8%) had no formal education. This implies that coffee farming is dominated by individuals with limited schooling, which may hinder their ability to adopt modern technologies, access credit, or engage in the markets. These results align with those of Bekele and Guadie (2020) in Ethiopia, who found

that education significantly influences coffee production by enabling farmers to adopt improved technologies and access extension services. Likewise, Corsini *et al.* (2018) in Brazil emphasized that education shapes farmers' socio-economic profile, with higher education linked to diversification, professionalism, and cooperative engagement.

3.1.4. Household size of respondents

The findings in Table 1 revealed that more than half of the respondents (56.6%) had households with 4-6 members, 27.5% had 1-3 members, 14.1% had 7-9 members, and only 1.8% had households with more than 10 members. This indicates that most households have a moderate family size, which may be useful for providing family labour during coffee production. The predominance of households with 4-6 members in Myangayanga Ward suggests that most farmers have access to adequate family labour, which can positively influence production, information use, and marketing efficiency, thereby improving overall coffee-farming outcomes. Similar findings were reported by Tegegn et al. (2024) in Wolaita Zone, Ethiopia, where household size significantly influenced coffee production: larger households provided more labour, reducing reliance on hired workers and enhancing productivity. In line with this, Akinpelu et al. (2021) in Nigeria observed that household size also played

a critical role in coffee marketing, as family members supported harvesting, processing, and transporting produce to markets, thereby lowering costs and improving participation. Likewise, Gutama et al. (2019) noted that households with more members were more likely to use information from coffee production packages, as larger family structures enhanced knowledge sharing and facilitated the adoption of recommended practices.

3.1.5. Years in farming of respondents

Results in Table 1 indicated that 40.1% of respondents had 11-20 years of coffee farming experience, 30% had 1-10 years, 10.1% had 31-40 years, and 9.8% had 21-30 years. Most farmers possess considerable knowledge of coffee production, which enhances productivity and farm management. Farming experience determines agricultural productivity by influencing farmers' ability to make informed decisions and apply improved practices. Tambi (2023) found that farming experience was critical for coffee production in Cameroon, as experienced farmers showed better management skills and resilience. Similarly, Boshe and Zone (2024) in East Wollega, Ethiopia, found that more experienced farmers were more likely to participate in coffee production and to increase productivity. A longer experience in coffee production may contribute to the output and livelihood outcomes in the study area.

Table 1: Demographic Characteristics of Respondents (n = 327)

Variable	Category	Frequency	Percentage (%)
Age (yrs)	20–30	53	16.2
	31–40	64	19.6
	41–50	78	23.9
	Above 50	132	40.4
Gender	Male	285	87.2
	Female	42	12.8
Education level	No formal education	9	2.8
	Primary education	256	78.3
	Secondary education	47	14.4
	Tertiary education	15	4.6
Household size	1-3	90	27.5
	4-6	185	56.6
	7-9	46	14.1
	above10	6	1.8
Years in farming (Years)	1–10	98	30.0
	11–20	131	40.1
	21–30	32	9.8
	31–40	33	10.1
	41–50	33	10.1

3.2. Status of coffee production and marketing in Mbinga District
3.2.1. Land size under coffee production

Results in Table 2 showed that coffee production among smallholder farmers is mainly on small to medium plots: 31.2% cultivate less than 1 acre, 39.8% cultivate between 1 and 3 acres, and only 29.0% cultivate more than 3 acres. These findings indicate

that most farmers rely on limited land, which constrains production and affects income, especially for those with less than an acre. A study by Widyawati *et al.* (2024) from Indonesia found that land size strongly influences coffee output, while Venugopal and Dash (2023) observed that smaller landholdings weaken farmers' bargaining power in India's coffee value chain. Thus, the Tanzanian case reflects broader

regional patterns in which landholding disparities shape smallholder farmers' livelihoods.

Table 2: Size of Land Allocated to Coffee Production (in Acres)

Land Size (Acres)	Frequency	Percent(%)
<1	102	31.2
1–3	130	39.8
>3	95	29.0
Total	**327**	**100.0**

3.2.2. Number of coffee trees

Results in Table 3 indicated that 38.8% of farmers owned 501-1500 coffee trees, 37.9% managed less than 500 trees, and 23.3% cultivated more than 1500 trees, indicating that most operate under small-to medium-scale holdings. According to Kiyingi and Gwali (2012), one acre comprises 340-450 coffee trees. In one acre, one can produce 0.486 to 0.748 tonnes of coffee. This distribution implies that a considerable proportion of farmers are constrained in their ability to maximise production and income due to limited numbers of trees. In contrast, those with more than 1500 trees are comparatively better positioned to achieve economies of scale and higher profitability. Many farmers are constrained in maximizing production and income due to limited tree numbers, while those with over 1500 trees are better positioned to achieve economies of scale and profitability. According to Ngango and Kim (2019), coffee tree ownership is directly connected to potential income. However, it is influenced by factors such as extension services, agricultural inputs, credit access, production efficiency, and market availability. In line with these findings, key informants indicated that the number of coffee trees largely determines production capacity and income potential, particularly when combined with adequate management practices. As noted by a district agricultural officer:

> *"………Farmers with more coffee trees can produce larger volumes and earn more income, especially when they manage their farms well. Those with few trees often struggle to generate sufficient output, even if prices are favourable, which limits their overall income……..."* *(District Agricultural Officer, Mbinga District).*

Table 3: Number of Coffee Trees Owned by Smallholder Farmers

Number of Trees	Frequency	Percent(%)
<500	124	37.9
501–1500	127	38.8
>1500	76	23.3
Total	**327**	**100.0**

3.2.3. Type of coffee produced

Results in Figure 1 revealed that Arabica coffee predominates in the study area, with 81.7% of farmers cultivating it, compared to 11.9% producing Robusta and 6.4% cultivating both. This suggests that the region's ecological conditions favour Arabica cultivation, leading most producers to choose it over Robusta. The results of this study align with those of Rothwell *et al.* (2019)**,** who emphasized that Arabica coffee has a more diverse and favourable chemical composition than Robusta coffee. Furthermore, it possesses distinctive sensory qualities that garner higher consumer preferences globally. Similarly, Volsi *et al.* (2019) noted that global coffee dynamics, particularly in Brazil, showed a strong inclination toward Arabica production due to its higher market value and long-term profitability. However, the heavy reliance on Arabica may expose farmers to production risks, such as climate variability and disease susceptibility, which are often greater for Arabica than for Robusta. Consistent with these findings, key informants explained that farmers' preference for Arabica coffee is driven by both ecological suitability and market incentives, despite the associated production risks. As noted by a cooperative leader:

> *"……….Arabica coffee dominates in this area because it performs well under local climatic conditions and attracts better prices in the market. Farmers are aware of the risks from pests and climate change, but they continue to grow Arabica because it offers higher income potential than Robusta......"* *(Cooperative Leader, Myangayanga Ward)*
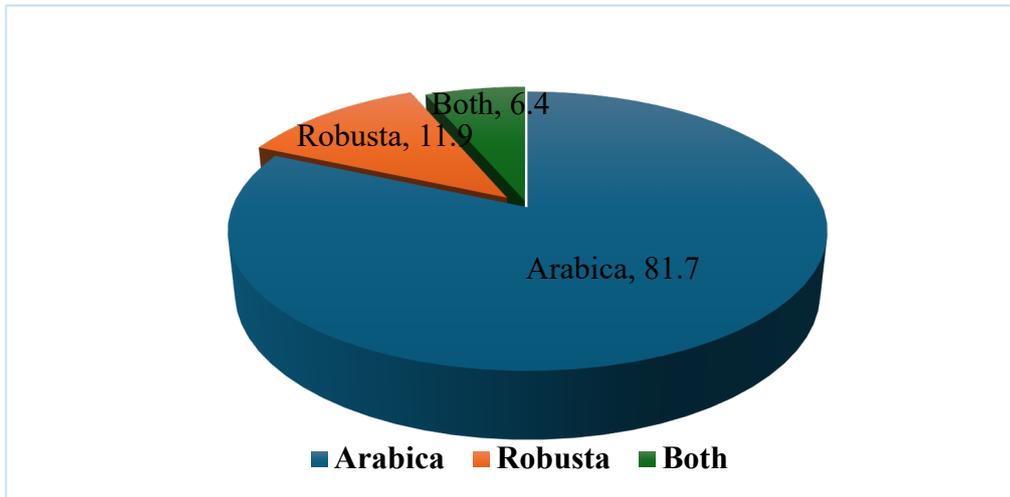
Figure 1: Type of Coffee Produced by Smallholder Farmers

3.2.4. Years of producing coffee

Results in Table 4 showed that 28.7% of farmers had engaged in coffee production for 1–5 years, 24.5% for 6–10 years, and 22.3% for more than 20 years. Experience among long-term farmers may contribute to improved farm management, the adoption of effective practices, and resilience to challenges, while newer farmers demonstrate ongoing interest in coffee as an economic activity, though this may signal generational replacement rather than youth attraction. These findings align with Boshe and Zone (2024), who found that farmer participation in coffee production is influenced by socio-economic characteristics, such as experience and resources, with experienced farmers producing more. Tambi (2023) highlighted that in Cameroon, years of engagement in coffee farming affect efficiency and decision-making, as experienced farmers adopt sustainable practices. However, the high proportion of new entrants suggests that while coffee remains attractive, support through training, inputs, and extension services is critical for both novice and long-term farmers to maximize productivity and ensure sustainability. Consistent with these findings, key informants indicated that farming experience enhances decision-making, productivity, and income outcomes, particularly when combined with access to extension support. According to a district agricultural officer:

> *"....Farmers who have spent many years in coffee production understand crop management, seasonal risks, and market behaviour better. Their experience enables them to make informed decisions, resulting in higher productivity and more stable income compared to new entrants without adequate technical support…....." (District Agricultural Officer, Mbinga District)*

Table 4: Years Engaged in Coffee Production

Years Producing Coffee	Frequency	Percent (%)
1–5	94	28.7
6–10	80	24.5
11–20	80	24.5
>20	73	22.3
Total	**327**	**100.0**

3.2.5. Use of farm inputs

Results in Figure 2 illustrated that pesticides constitute the most frequently utilized agricultural input (40.1%), followed by fertilizer. The results in Figure 2 show that pesticides constitute the most frequently used agricultural input at 40.1%, followed by fertilizers 36.4% and improved seedlings 23.5%. These results suggest that the adoption of inputs among coffee farmers is moderate, with a predominant focus on pest control rather than yield-enhancing technologies, such as improved seedlings. This indicates that although farmers are cognizant of immediate pest threats, their limited adoption of improved seedlings may constrain their long-term productivity and profitability. Reliance on pesticides without a commensurate investment in enhanced planting materials may confine farmers to damage control rather than augmenting their output potential. This observation is consistent with Sajjad *et al.* (2022), who posited that farmers' input decisions are influenced by risk aversion and a preference for safeguarding existing yields over maximizing future gains. Reader *et al.* (2018) emphasized that expenditure on variable inputs, such as fertilizers and pesticides, maximizes yields but may not optimize profits when investments in improved seedlings are overlooked. The findings of this study underscore the importance of enhancing access to and awareness of improved seedlings, alongside balanced fertiliser application and pest management, to increase productivity and

sustainable income growth among smallholder coffee farmers. In line with these findings, key informants explained that farmers' emphasis on pesticides reflects cost constraints and limited access to yield-enhancing inputs rather than a lack of awareness. As noted by an agricultural extension officer:

"....Many farmers focus mainly on pesticides to protect their existing coffee trees, but investment in fertilizers and improved seedlings remains low due to high costs and limited availability. This imbalance limits long-term productivity by prioritizing damage control over sustained yield improvement......." (Agricultural Extension Officer, Myangayanga Ward)

	Fertilizer	Pesticides	Improved seedling
■ Percent	36.4	40.1	23.5
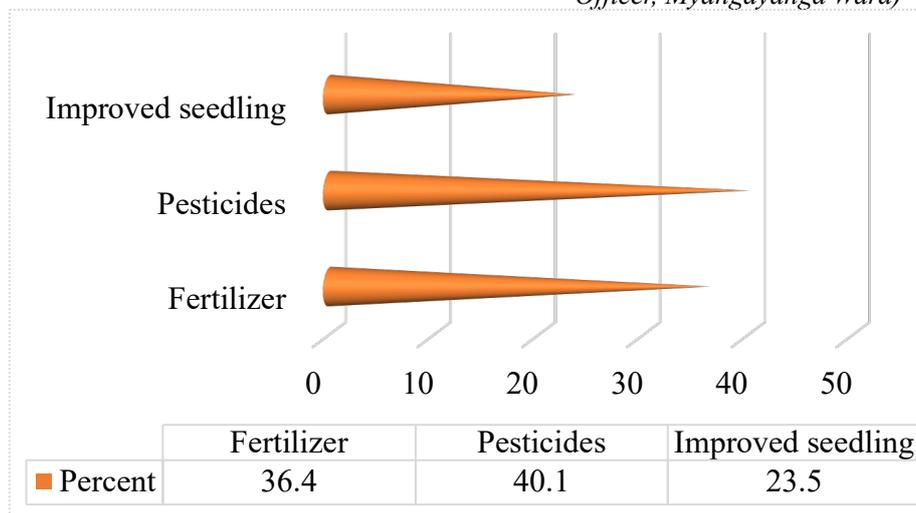
Figure 2: Use of farm Inputs in Coffee Production

3.2.6. Average annual coffee yield

The mean yield was 2.03, indicating that, on average farmers fall within the moderate production category. The results in Table 5 showed that the majority of respondents 37.3% produce between 500 and 1000 kilograms of coffee annually, followed by 32.7% who produce above 1000 kilograms and 30.0% who produce below 500 kilograms. These data presented indicate that most farmers in the study area have moderate coffee production levels, while a considerable proportion attain relatively high yields. However, the existence of a notable group with low production suggests disparities in productivity, which could be linked to differences in access to farm inputs, farming techniques, or environmental conditions. Mbwambo et al. 2021 (Kiwelu et al., 2021; Mbwambo et al.). These findings align with studies showing that adopting improved varieties and proper agronomic practices significantly enhance yield, while reliance on traditional methods and climate-related challenges constrain output. The implications of this variability suggest the need for targeted interventions to improve access to quality inputs, extension services, and climate-smart farming practices, thereby increasing household incomes, enhancing food security, and promoting overall socio-economic development among smallholder coffee farmers in Mbinga district. Consistent with the observed variability in coffee yields, key informants emphasised that productivity differences arise from management practices rather than from land size alone. According to an agricultural extension officer:

"............Income differences are driven more by how farmers manage their coffee trees than by land size. Farmers who apply recommended inputs, prune correctly, and manage pests effectively achieve higher yields and incomes even on relatively small plots............" (Agricultural Extension Officer, Myangayanga Ward).

Table 5: Distribution of respondents by average annual coffee yield

Average Annual Coffee Yield (kg)	Frequency (n)	Percent (%)
Below 500	98	30.0
500–1000	122	37.3
Above 1000	107	32.7
Total	**327**	**100.0**
Mean yield	**2.03**	**–**

3.2.7. Price per kilogram of coffee

The mean price category was 1.49, indicating that, on average, farmers receive prices falling within the lower price category. Table 6 indicates that 51.4% of farmers sold their coffee for less than TZS 9,000 per kilogram, while 48.6% sold it for between TZS 9,000 and 9,500 per kilogram. The findings of this study indicate that there is no fixed price for coffee production. Nearly half of the farmers achieve comparatively higher prices, while the majority still sell at lower rates, potentially limiting their profitability and overall income from coffee production. These results imply that most farmers sell their coffee at relatively low prices, which can constrain their income. According to Ruben (2023), coffee price instability has affected the income of smallholder farmers; thus, they are encouraged to diversify their undertakings to support their livelihoods. Consistent with these institutional challenges, some farmers explained that immediate cash needs shape their marketing decisions. As expressed by one smallholder coffee farmer:

"....We prefer selling to the local market and to middlemen because, although the price is small, they pay us immediately, while the cooperative union delays the payments…...." (Male farmer, 29 years old, 14th July2025).

Additionally, interviews with cooperative leaders revealed that payment structures and household liquidity needs strongly influence pricing outcomes. As noted by one cooperative leader:

"....Although cooperatives generally offer better prices than local buyers, payment delays pose serious challenges for farmers. Many households have urgent needs such as school fees and food expenses, which force them to sell to middlemen who pay immediately, even when the price offered is lower…......" (Cooperative Leader, Myangayanga Ward)

Table 6: Price per kilogram of coffee

Price per Kilogram TZS	Frequency	Percent(%)
<9000	168	51.4
9000–9500	159	48.6
Total	**327**	**100.0**
Mean price	**1.49**	

3.2.8. Total annual income from coffee sales

The mean annual income from coffee was TZS 3,695,069.11, indicating that it contributes significantly to household earnings. Results in Table 7 showed that 26.9% of farmers earned below TZS 1,000,000, 24.2% earned between TZS. 1.68-2.77 million, 23.2% earned between TZS 2.77-4.62 million, and 25.7% earned above TZS 4.62 million per annum. The income distribution among coffee farmers is fairly balanced, although many remain in the low-income brackets. While coffee farming provides substantial earnings for approximately a quarter of farmers, many smallholders face vulnerability and low profitability, highlighting the varied production outcomes. According to Amir *et al.* (2024)**,** coffee contributes to household income, but the extent varies based on productivity levels, market access, and input use. Banjade and Atreya (2021) demonstrated that in Nepal, coffee income is determined by farm size, management practices, and access to extension services, showing that better-resourced farmers achieve higher earnings. Nibret and Ayalew (2020) noted that in Ethiopia, income differences among coffee households stem from variations in the production scale and market stability. Furthermore, results in Table 6 revealed that the average annual income from coffee production was TZS 3,695,069.11, ranging from TZS. 375,000 to TZS 45,000,000, with a standard deviation of TZS. 3,596,646.22, while income from other sources, such as other crops, livestock keeping, business, and off-farm employment, averaged TZS 1,542,350.75, ranging between TZS 250,000 and TZS 10,000,000, with a standard deviation of TZS. 985,430.25. The mean difference of TZS 2,152,718.36 indicated that coffee production contributes substantially more to household income than other activities. This result implies that coffee serves as the primary source of livelihood for most smallholder farmers in the study area, while other sources provide supplementary income. However, the wide income range and high standard deviation suggest significant disparities among farmers, likely driven by differences in land size, productivity, access to inputs, and market opportunities. The results emphasize that enhancing coffee productivity and market access could significantly improve household income and well-being. Yet, overreliance on coffee exposes farmers to price fluctuations and climate-related risks. Therefore, promoting income diversification through complementary activities, such as other crops, livestock keeping, off-farm work, and business, would strengthen household resilience. These findings are consistent with studies by (Mapunda *et al.,* 2018; Ngambila *et al.,* 2024) who reported coffee as the dominant income source among smallholders in Mbinga and Rungwe Districts, respectively, and to Hartatri *et al.* (2021) in Simalungun, North Sumatera, Indonesia, who

found that smallholder coffee farmers primarily rely on coffee as their main source of income. Still, those who diversify their livelihoods, such as by engaging in small businesses or livestock activities, tend to experience greater income stability and reduced vulnerability to market shocks. This consistency across studies reinforces the argument that while coffee production significantly enhances household income, diversification is an essential strategy for sustaining livelihoods and mitigating risks in smallholder coffee-dependent communities. In line with these findings, qualitative evidence from respondents further illustrates the central role of coffee income in sustaining household livelihoods and meeting essential needs. As expressed by one smallholder coffee farmer:

"...Coffee is our main source of income year-round. When the coffee harvest is good, our families live better; we can pay school fees and meet household needs. But when prices fall, or the harvest is poor, it becomes challenging because other activities like livestock and business, farm employment and other crops do not bring much money………." (Male coffee farmer, 42 years old, Myangayanga ward, 20th July2025).

Table 7: Estimated Annual Household Income from Coffee and other sources

Variable / Income Category (TZS)	Frequency	Percent (%)	Minimum (TZS)	Maximum (TZS)	Mean (TZS)	Std. Deviation (TZS)
Below 1,000,000	88	26.9	–	–	–	–
1,680,001 – 2,775,000	79	24.2	–	–	–	–
2,775,001 – 4,625,000	76	23.2	–	–	–	–
Above 4,625,001	84	25.7	–	–	–	–
Total Household	**327**	**100.0**	–	–	–	–
Income Distribution						
Average Annual Household Income from Coffee Production	–	–	375,000	45,000,000	3,695,069.11	3,596,646.22
Average Annual Household Income from Other Sources	–	–	250,000	10,000,000	1,542,350.75	985,430.25
Mean Income Difference	–	–	–	–	2,152,718.36	–

3.2.9. Market accessibility

Results in Table 8 showed that 68.8% of farmers sold coffee through cooperatives, 19.9% through local markets, and 11.3% through middlemen. These findings indicate a preference for organized marketing channels. Most farmers are leveraging cooperatives, which enhance collective bargaining, reduce exploitation risks, and improve access to better prices, while those using local markets and middlemen remain vulnerable to low profits. This aligns with Abdullah (2017), who emphasized that access to structured markets is crucial for rural development, as local reliance often limits economic opportunities. Similarly, Ahmed *et al.* (2017) found that market access plays a central role in enhancing smallholder food security in Pakistan, as better-connected farmers enjoy higher income stability than less-connected farmers. Schuit *et al.* (2021) demonstrated that, in Ethiopia, integrating smallholders into organised and speciality markets improves farmers' incomes and supports biodiversity conservation, highlighting the benefits of cooperative marketing. The findings suggest that strengthening cooperative capacity and expanding access to competitive markets are essential for reducing dependence on mediators, mitigating exploitation risks, and enhancing income and sustainability among smallholder coffee farmers. In line with the observed contribution of coffee to household income and the vulnerability associated with income fluctuations, qualitative evidence from respondents further illustrates farmers' heavy dependence on coffee production for livelihoods. As expressed by one smallholder coffee farmer:

"……Although cooperative marketing offers significant benefits through collective bargaining and better prices, we are sometimes compelled to sell through local markets or middlemen due to delayed payments from the cooperative, forcing us to seek immediate cash despite potential reductions in profit……" (Male farmer, 35 years old, 17thJuly2025).

Table 8: Coffee Marketing Channels Used by Smallholder Farmers

Marketing Channel	Frequency	Percent(%)
Local market	65	19.9
Cooperatives	225	68.8
Middlemen	37	11.3
Total	**327**	**100.0**

3.2.10. Chi-Square analysis showing the association between status coffee production variables and income levels

Findings in Table 9 revealed that certain farm characteristics strongly influence income levels among smallholder coffee farmers. Specifically, the number of coffee trees maintained (χ^2 = 22.16, p = 0.001), years of farming experience (χ^2 = 28.10, p = 0.001), and use of farm inputs including fertilisers, improved seedlings, and pesticides (χ^2 = 30.99, p = 0.000) were significantly associated with higher income (Bolka, 2025; Ifadah *et al.,* 2025; Kimaro, 2020; Tolesa, 2025). Farmers who maintain more than 1,500 trees, have over 20 years of experience, or consistently apply improved seedlings and fertilizers achieve higher income levels, highlighting the importance of tree density, experiential knowledge, and input usage for improved productivity and earnings. Conversely, land size under coffee production (χ^2 = 10.13, p = 0.119) and the type of coffee cultivated (χ^2 = 6.98, p = 0.323) were not significantly associated with income, although larger farms and certain coffee types showed positive trends (Anderzén *et al.,* 2020;

Kangile *et al.,* 2021; Kimaro, 2020; Kiwelu and Damas, 2022). This indicates that income outcomes are determined less by farm size or coffee variety, and more by factors such as productivity per acre, adoption of improved practices, market access, and diversification strategies. These findings suggest that smallholder farmers should prioritise efficiency, technology adoption, and quality improvements over simply expanding land or choosing a particular coffee type. Furthermore, higher annual coffee yields (χ^2 = 15.18, p = 0.019) and favourable farm-gate prices (χ^2 = 10.99, p = 0.012) were significantly associated with improved income levels (Ifadah *et al., 2025; Leiva et al.,* 2024; Wubie, 2024). Farmers producing more than 1,000 kg or selling coffee at higher prices earned substantially more, underscoring the critical roles of yield optimisation and market integration. Overall, the results demonstrate that a combination of financial, human, and physical capital, aligned with the Sustainable Livelihoods Framework, determines household income, and that policies promoting productivity, input access, and market support can effectively enhance livelihoods among smallholder coffee farmers in Mbinga District

Table 9: Chi-Square analysis showing the association between status coffee production variables and income levels

Variable	Category	Income levels among smallholder farmers (TZS)				χ^2	p-value
		Below 1,000,000	1,680,001–2,775,000	2,775,001–4,625,000	Above 4,625,000		
Land size under coffee cultivation (Acres)	<1	37 (36.3)	22 (21.6)	25 (24.5)	18 (17.6)	10.13	0.119
	1–3	30 (23.1)	35 (26.9)	30 (23.1)	35 (26.9)		
	>3	21 (22.1)	22 (23.2)	21 (22.1)	31 (32.6)		
Number of coffee trees (N)	<500	46 (37.1)	26 (21.0)	30 (24.2)	22 (17.7)	22.16	0.001*
	501–1500	29 (22.8)	37 (29.1)	31 (24.4)	30 (23.6)		
	>1500	13 (17.1)	16 (21.1)	15 (19.7)	32 (42.1)		
Average annual coffee yield (Kg)	<500	30 (30.6)	28 (28.6)	22 (22.4)	18 (18.4)	15.18	0.019*
	500–1000	40 (28.6)	34 (24.3)	36 (25.7)	30 (21.4)		
	>1000	18 (20.2)	17 (19.1)	18 (20.2)	36 (40.4)		
Type of coffee produced	Arabica	71 (26.6)	69 (25.8)	57 (21.3)	70 (26.2)	6.98	0.323
	Robusta	11 (28.2)	9 (23.1)	11 (28.2)	8 (20.5)		
	Both	6 (28.6)	1 (4.8)	8 (38.1)	6 (28.6)		
Years of producing coffee (Yrs)	1–5 yrs	35 (37.2)	30 (31.9)	14 (14.9)	15 (16.0)	28.1	0.001*
	6–10 yrs	24 (30.0)	20 (25.0)	19 (23.8)	17 (21.3)		
	11–20 yrs	20 (25.0)	13 (16.3)	23 (28.8)	24 (30.0)		
	>20 yrs	9 (12.3)	16 (21.9)	20 (27.4)	28 (38.4)		
Use of inputs (type)	Fertilizer	25 (21.0)	31 (26.1)	28 (23.5)	35 (29.4)	30.99	0.000*
	Pesticides	54 (41.2)	29 (22.1)	29 (22.1)	19 (14.5)		
	Improved seedling	9 (11.7)	19 (24.7)	19 (24.7)	30 (39.0)		
Price per kilogram of coffee (TSh/kg)	<9000	56 (33.3)	43 (25.6)	36 (21.4)	33 (19.6)	10.99	0.012*
	9000–9500	32 (20.1)	36 (22.6)	40 (25.2)	51 (32.1)		

Note: Percentages are shown in brackets * Denotes significance at the 1% level; and ** at the 5% level

4. Conclusion and Recommendations

Coffee production significantly enhances household income and sustains the livelihoods of smallholder farmers in the Mbinga District. However, income disparities arise from factors such as landholding size, access to agricultural inputs, and market participation. Larger farm sizes, better market availability, and improved access to inputs are directly correlated with higher productivity levels among these farmers. This underscores the need for stable market conditions and reliable provision of agricultural inputs to support consistent coffee production in the country. Moreover, the positive relationships identified between income and variables such as the number of coffee trees, years of farming experience, input use, yield, and market prices emphasis that both technical expertise and institutional support structures are vital for improving farmer welfare. To strengthen this sector, local and central governments should focus on capacity-building initiatives to ensure farmers have access to improved seedlings, fertilisers, and timely market information. Such interventions will enhance the productivity and income generation of smallholder coffee producers. Additionally, encouraging diversification into activities such as livestock rearing and off-farm employment can help farmers build resilience to price fluctuations and climate-related shocks.

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