AB Journals

African Journal of Economics and Sustainable Development
ISSN 2689-5080 • Volume 9, Issue 5, 2026 • pp. 19–34

RESEARCH ARTICLE Received: 7 Sep 2026, Accepted: 20 Oct 2026, Published: 12 Nov 2026

Market Constraints and Commercialisation among Smallholder Farmers in Northern Ghana

Adam Iddrisu, Ph.D.[*]; Yahaya Abdulai, Ph.D.[2]; Yussif Abukari[3]

Faculty of Agriculture and Natural Environment, Department of Agribusiness, Tamale Technical University.

[*]*Corresponding Author's Email: nyabadam@gmail.com*

Abstract

This study examines maize commercialisation intensity, determinants, and the major constraints confronting smallholder maize farmers in Tolon District of Northern Ghana. A cross-section of 125 maize farmers was selected through a multistage sampling procedure. The study measures commercialisation intensity using the Household Maize Commercialisation Index and employs a fractional logit model with robust standard errors to identify associated factors. The constraints of farmers were analysed through the Friedman test and Kendall's coefficient of concordance. The results showed that 52.5% of the maize harvested had 70.5 medium-level market participants. Commercialisation intensity was positively correlated with education, household size, area cultivated with maize and access to market information. But negatively correlated with gender, farming experience, distance to market, transportation costs and access to credit. The farmers perceived low output prices, high production costs, and price fluctuations as three major challenges with substantial agreement. The study recommends improving access to farm inputs, strengthening maize markets and price information systems to expand collective marketing arrangements. These measures can improve the profitability and sustainability of smallholder maize commercialisation in Northern Ghana.

Keywords: Commercialisation, Fractional Logit, Maize, Northern Ghana, Smallholder Farmers

How to Cite: Iddrisu, A., Abdulai, Y., & Abukari, Y. (2026). Market Constraints and Commercialisation among Smallholder Farmers in Northern Ghana. African Journal of Economics and Sustainable Development, 9(5), 19–34. https://doi.org/10.52589/AJESD-QEDGFK

© 2026 by the authors. Published by AB Journals. This is an open access article distributed under the terms of the Creative Commons Attribution (CC BY 4.0) license.

INTRODUCTION

Agriculture commercialisation is widely viewed as a critical process for the transition of smallholder agriculture from a largely subsistence-based activity into a more market-responsive and income-generating one (Li et al., 2023; Konja et al., 2023). Also, a market-oriented production system is said to increase the potential for farm household commercialisation (Julius et al., 2022). Commercialisation is more than just the sale of farm output; it is a measure of the extent to which production decisions made at the household level are driven by market incentives and the proportion of agricultural output marketed (Barrett, 2008). Higher levels of commercialisation can allow farm households to earn cash income; however, this is not automatic. Farmers' ability to respond to market opportunities depends on their productive capacities, access to information and other farm-related characteristics (Mzyece et al., 2023).

These issues are particularly important in northern Ghana where smallholder agriculture is still central to rural livelihoods. In addition, maize is a major staple food and an important source of farm income. Maize production is characterised by seasonal supply, fluctuating prices and imperfect market information (Iddrisu et al., 2025).

Existing evidence on maize production and market participation shows that farm size, household characteristics, distance to markets and access to market information influence the level of market participation of maize and rice farmers in northern Ghana (Iddrisu et al., 2025). This underscores the significance of key determinants such as market information and transaction costs under commercialisation decisions. In the same line, Abdallah et al. (2021) also established that market information, access to extension, marketable surplus and farming experience influence maize market participation and intensity in northern Ghana. Despite this empirical evidence, the constraints limiting smallholder farmers from increasing their market potential and welfare need to be addressed.

The more relevant question and empirical gap for this study is that; what determines the extent to which already-participating farmers commercialise their maize and what constraints prevent them from increasing their marketable share? Much of the commercialisation literature focuses on whether farmers participate in markets, whereas participation alone does not adequately show the degree to which market-oriented production occurs. This is particularly important in the present study because all sampled maize farmers had sold part of their output. Consequently, a binary participation model would have limited discriminatory power.

The present study addresses this gap by focusing on smallholder maize farming communities in the Northern region. The setting provides an appropriate context for examining commercialisation because farmers simultaneously respond to household food requirements and still sell a proportion of harvested produce at different farm household levels. The study employs a fractional logit model, which provides a more suitable framework for explaining proportional outcomes and complements the econometric analysis with a ranking of farmers' maize commercialisation constraints.

The study makes three principal contributions to knowledge. First, the study analyses move beyond market participation determinants to commercialisation intensity among maize farmers who consume more of the crop and sell it again in the market. The application of a fractional-response framework provides practical evidence for policy decisions in identifying specific barriers of commercialisation intensity of maize as a staple crop. Also, it provides evidence on the constraints of maize farmers that prompt policy prioritisation for farmers in Northern

Ghana. The study therefore addresses three specific objectives: first, it establishes the extent and distribution of maize commercialisation among smallholder farmers in Tolon District. Secondly, it identifies and ranks the major constraints faced by farmers in maize markets. Finally, it analyses the socioeconomic and institutional factors associated with the intensity of maize commercialisation. The study's findings are expected to contribute to policy decisions that go beyond just increasing the volume of maize sales. Rather, it seeks to promote a market environment which will enable farmers to commercialise more efficiently along the maize value chain. The above gives details of the introduction, and the remainder of the paper is organised as follows. The next section reviews the relevant literature and presents the theoretical and conceptual frameworks. The Materials and Methods section describes the study area, sampling procedure and data collection, and explains how marketing constraints and their determinants were analysed. The results and discussion section presents the results, including farmers' commercialisation levels, and the factors associated with commercialisation intensity. The last section concludes the paper and discusses its implications for research and practice.

LITERATURE REVIEW

Theoretical Framework

The theoretical framework of the study considered a process through which farm households sell an increasing proportion of their agricultural output to markets. The process is influenced by the interaction of production capacity, household consumption needs, market incentives and costs of entry into agricultural markets. This study is mainly based on Transaction Cost Economics, complemented by the Agricultural Household Model. Transaction Cost Economics holds that market exchange is associated with costs beyond the commodity price, such as the costs of finding buyers, price information, and transactions (Williamson, 1985; Barrett, 2008). In this context, distance to market, transport costs, market information and farmers' constraints may affect maize-selling returns. Because households retain maize for consumption, the study examines the proportion of harvest sold rather than participation alone.

The agricultural household perspective recognises that smallholders are simultaneously producers and consumers. Total harvested maize by the farmer is therefore allocated among market sales, household consumption, seed and storage, and transfers or other post-harvest uses. This can be expressed as:

$$Q = Q_m + Q_c + Q_s + Q_t \quad (1)$$

where Q is total maize produced by the farmer, Q_m is quantity marketed, Q_c is household consumption of the farmer, Q_s is maize retained for household consumption and seed, and Q_t represents transfers and other uses. Consequently, commercialisation involves a trade-off between the expected net benefits of selling maize and the value of retaining it for household needs. Commercialisation intensity is measured as:

$$MCI = \frac{Q_m}{Q} \quad (2)$$

where higher values indicate a greater proportion of output marketed. The framework therefore directly supports the study objectives of determining the commercialisation levels of the farmers and constraints of market participation. As such, the framework conceptualises maize commercialisation as a continuum based on the interaction of production capacity, household retention needs, market incentives, institutional conditions and transaction costs.

Conceptual Framework

The conceptual framework (Figure 1) integrates agricultural commercialisation theory, the agricultural household perspective, and transaction-cost economics to explain variations in smallholder maize commercialisation intensity. Following Barrett (2008), smallholder households allocate production between consumption and markets, with commercialisation shaped by productive capacity, market incentives, institutional support and transaction costs.

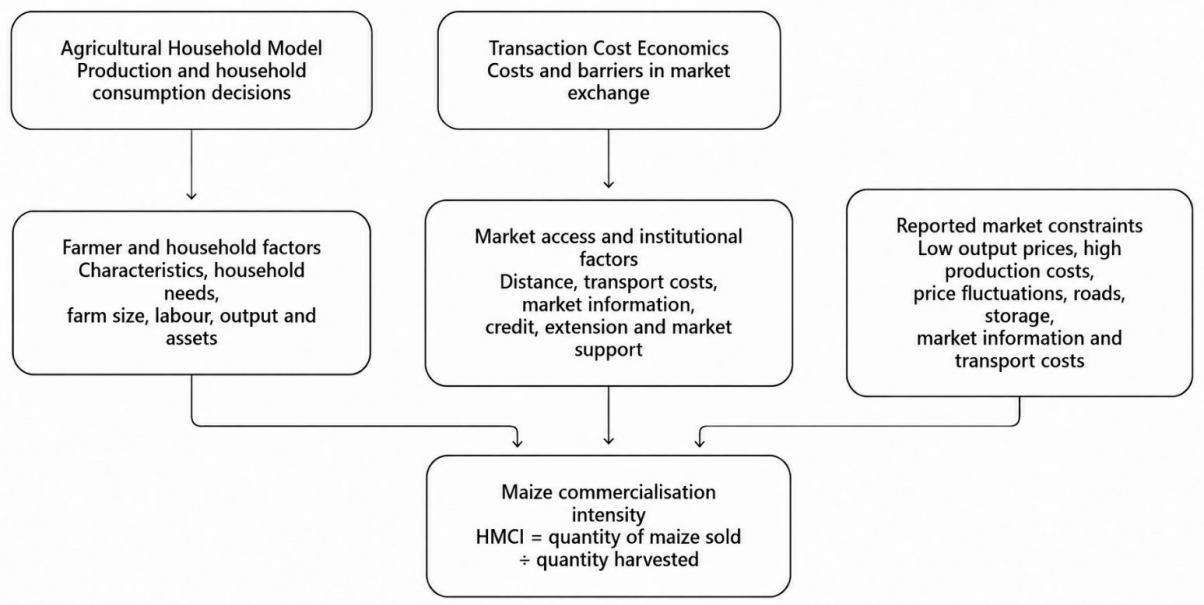


Figure 1: Conceptual Framework of the study (Adapted from Singh et al.,1986; Key et al., 2000; Barrett, 2008)

Drawing on the Agricultural Household Model, it recognises that farm households make production and consumption decisions and allocate harvested maize between sales and household needs. Transaction Cost Economics explains how market access, information, transport and other exchange costs may influence the share of maize farmers sell. The framework therefore proposes that commercialisation intensity increases where productive capacity and institutional support facilitate market access while transaction costs and structural constraints are reduced.

MATERIALS AND METHODS

Study Area

The study was conducted in Tolon District in the Northern Region of Ghana. The study was undertaken in Tolon township and its surrounding maize-producing communities. The district is located within the Guinea Savannah agro-ecological zone and has a unimodal rainfall pattern, with agriculture as the main economic activity (Ghana Statistical Service, 2021). Important staple foods like maize, rice, sorghum, millet, groundnut and legumes are grown by smallholder farmers.

Maize is an important crop, along with other staples such as rice and groundnut, consumed by households and traded largely in the Northern region (MoFA, 2024). The town therefore acts as an important local outlet for farmers and a major market to sell their produce through an

informal market system. This makes it an appropriate setting for examining the factors and constraints influencing maize commercialisation among smallholder farmers.

Sampling and Data Collection Procedure

The study used primary cross-sectional data collected from 125 smallholder maize-farming households in Tolon District. A multistage sampling procedure was used. First, Tolon township was purposively selected because it serves as a maize aggregation and marketing centre for surrounding communities. Second, maize-producing households that sold maize through the Tolon market were identified. Third, simple random sampling was used to select 125 eligible farmers for interviews. The questionnaire was pilot-tested among maize farmers in Fehini Community having similar farmer and household characteristics with study communities. The feedback informed wording revisions, supporting face and content validity.

Data were collected through face-to-face interviews using a structured questionnaire administered to farm household heads. Where needed, spouses and other household members assisted respondents in recalling household production and marketing information. Their participation helped clarify responses, although recall and self-reporting errors may still have occurred. Simple random selection reduced discretion in choosing respondents within the identified group of maize sellers.

The cross-sectional design captures farmers' circumstances at one point in time and therefore supports analysis of associations, rather than firm conclusions about causality. In addition, because the sample comprised farmers who sold maize through the Tolon market, the findings may not represent non-selling maize farmers or farmers in other districts. The results should therefore be interpreted within the study's geographic and sampling scope.

Measurement of Maize Commercialisation

To evaluate the extent of market integration among smallholders, the study specifies the Household Maize Commercialisation Index ($HMCI_i$), defined as the proportion of total harvest sold in the market:

$$HMCI_i = \frac{Q_{si}}{Q_{hi}} \tag{3}$$

where $HMCI_i$ is the commercialisation index for farm household i, bounded between 0 (complete subsistence) and 1 (fully commercialised production); Q_{si} is the total volume of maize sold by farm household i (kilogrammes) and Q_{hi} is the total volume of maize harvested by household i (kilogrammes).

Farm Households Constraint Analysis

In analysing market constraints, farmers were asked to identify the major constraints affecting maize marketing. The constraints included seven major issues that affect maize commercialisation; such as low output prices, high transportation costs, poor roads, lack of credit, and price fluctuations, among others. To determine the prevalence of each limitation, frequencies and percentages were calculated. The level of agreement among farmers in ranking the limitations was then determined using Kendall's coefficient of concordance (W).

Fractional-Response Model

The study employs a fractional logit model following Papke and Wooldridge (1996). Fractional-response models are preferable to simply applying Ordinary Least Square (OLS) because they respect the fractional nature of the dependent variable and avoid arbitrary transformations of observations at the boundaries.

The conditional expectation of the Household Maize Commercialisation Index ($HMCI_i$) given a vector of explanatory variables X_i is specified within a Fractional Response Model framework as:

$$E\left(HMCI_i \mid X_i\right) = G\left(X_i\beta\right) \tag{4}$$

where $G(\cdot)$ represents the logistic cumulative distribution function (CDF), mapping the linear predictor to the bounded interval [0,1].

The empirical econometric specification is formulated as follows:

$$E\left(HMCI_i \mid X_i\right) = G\left(\beta_0 + \sum_{j=1}^{n} \beta_j \gamma_{ij} + \varepsilon_i\right) \tag{5}$$

Where $HMCI_i$ is the Household Maize Commercialisation Index for household i; $G(\cdot)$ is the logistic link function $G(z) = \frac{\exp(z)}{1+\exp(z)}$.

β_0 is the intercept term and β_j is a vector of unknown parameters to be estimated, γ_{ij} is the explanatory variables; and ε_i is the error term. The explanatory variables are defined in Table 1 and provide details of variables employed in analysing the study objectives.

Table 1: Description of Explanatory Variables

Variable	Description Measurement	Expected Outcome
Dependent variables		
MCI	Maize Commercialisation Index (Percentage)	NA
Explanatory variables		
Age (years)	Age of household head (years)	-
Gender (dummy)	Gender of farmer (1 = Male, 0 = Female)	+
Farming experience (years)	Number of years in farming maize (Number)	+
Education (dummy)	Education of farmer (1= literate, 0; Otherwise)	+
Household size (number)	Number of people living in Household (Number)	+
Farm size of maize (acres)	Size of maize plot (acres)	+
Distance (km)	Distance from household to the market (km)	-

Transportation cost (GH¢)	Maize transportation cost (Ghana Cedis)	-
Access to credit (dummy)	Farmer access to credit (1= Yes, 0-No)	+
Market information (dummy)	Access to market information (1 =Yes, 0=No)	+

RESULTS AND DISCUSSION

Descriptive Statistics and Level of Maize Commercialisation

Table 2 presents the descriptive statistics of the socioeconomic, production and market characteristics of the sampled maize farmers in Tolon District. The mean age of the farmers was 40 years, indicating that the respondents were predominantly economically active adults with substantial farming experience. On average, farmers had 26.22 years of farming experience and a mean household size of 23 persons. Farmers cultivated an average of 5.29 acres of land under maize and harvested 1,171.20 kilograms of maize per season. Also, an average of 540 kilogrammes of maize were sold, representing a substantial marketable surplus. Farmers were located an average of 4.14 km from the nearest maize market, while the average reported transportation cost associated with maize production and marketing was GH¢35.96.

Furthermore, an average income of GH¢1,612.48 was realised by farmers per production, while GH¢10,119.68 average annual income made from total production with other crops per year.

Table 2: Descriptive Statistics of Respondents

Variable	Mean	Standard Deviation
Age (years)	40.78	10.93
Household size (persons)	23.71	10.97
Farming experience (years)	26.22	10.74
Total farm size (acres)	12.86	10.19
Land cultivated to maize (acres)	5.29	3.65
Maize harvested (kilograms)	1,171.20	878.49
Maize sold (kilograms)	540.8	281.66
Price per bag (GH¢)	303.36	31.77
Distance to nearest maize market (km)	4.14	1.52
Income from maize (GH¢) per season	1,612.48	659.19
Off-farm income (GH¢)	3,351.20	1,777.37
Total annual household income (GH¢)	10,119.68	4,155.38

Source: Field data, 2026

Maize Commercialisation Level of Farmers

The results in Table 3 show a mean commercialisation index of 52.23%, demonstrating significant variation in the degree to which individual farmers directed their maize production toward the market. The median level of commercialisation was 50.0%, indicating that farmers marketed about one-half of the maize produced.

Table 3: Distribution of Commercialisation Intensity

MCI Category	MCI range	Frequency	Percentage
Low commercialisation	≤33.3%	7	5.60%
Medium commercialisation	33.4–66.6%	99	79.20%
High commercialisation	≥66.7%	19	15.20%
Total		125	100.00%

Source: Authors' Analyses, 2026

The distribution of farmers across commercialisation categories in Table 3 further demonstrates the moderate nature of maize commercialisation in the study area. Using the conventional classification, 7 farmers (5.6%) were classified as low commercialisers, 99 farmers (79.2%) as medium commercialisers, and 19 farmers (15.2%) as high commercialisers. The overwhelming concentration of farmers in the medium category indicates that most farmers operate within an intermediate position in which maize serves simultaneously as a food-security crop and a source of cash income.

The finding is broadly consistent with evidence that agricultural commercialisation remains limited among Ghanaian smallholders. Abu et al. (2024), using fractional regression, reported relatively low commercialisation levels, with household crop commercialisation indices of 35.20%. The moderate commercialisation level of the study may reflect farmers' ability to produce a marketable surplus, but persistent constraints might prevent them from moving from medium to high levels of commercialisation. However, the present finding contrasts with studies emphasising stronger commercialisation among farmers who participate in organised markets. Konja and Abdulai (2024), for example, found that participation in collective input and output markets and joint participation were associated with higher yield and commercialisation among maize farmers in Northern Ghana.

Constraints to Maize Commercialisation Among Farmers

The study evaluated the ranking of constraints of maize farmers' commercialisation. The analysis in Table 4 considered a number of market-related constraints of farmers in relation to their commercialisation intensity. Accordingly, the Friedman test was employed to test whether the constraints differed systematically in their reported prevalence.

Table 4: Constraints Ranking of Maize Farmers

Rank	Constraint	Frequency	Percentage (%)	Mean rank
1	Low output prices	125	100	5.684
2	High production costs	118	94.4	5.488
3	Price fluctuations	117	93.6	5.46
4	Poor roads	61	48.8	3.892

5	Lack of storage	25	20	2.884
6	Poor market information	8	6.4	2.408
7	High transportation cost	0	0	2.184

Source: Field data, 2026 Kendall's coefficient of concordance: W = 0.722
Friedman test: $\chi^2(6) = 541.445$***

Kendall's coefficient indicates a strong degree of concordance among the farmers regarding the relative prominence of the constraints. The results show that farmers exhibit considerable agreement that price-related and production-cost constraints are more important than information, storage and transportation constraints. The results reveal that low output prices constitute the most pervasive constraint to maize commercialisation in Tolon, with the highest mean rank of 5.684. This confirms that it occupies the dominant position in the constraint hierarchy.

This finding is economically important because farmers' willingness to commercialise maize depends not simply on their ability to produce a marketable surplus, but also on whether the expected farm-gate price provides sufficient compensation for production, marketing and opportunity costs. The finding is consistent Abdallah et al. (2021), who found that maize commercialisation in Savelugu was influenced by production and institutional factors, reinforcing the importance of economic incentives for farmers in the region.

High production cost ranks second, with the mean rank of 5.488. The extremely high prevalence indicates that the commercialisation problem in Tolon begins before maize reaches the market. Farmers face production challenges that reduce the net return obtained from maize sales. The proximity of this constraint to low output prices is particularly revealing. A farmer may obtain a reasonable nominal maize price but still perceive marketing as unattractive when the cost of producing the maize is high.

Price fluctuations rank third, with a very small difference between the mean ranks of high production costs and price fluctuations, indicating that these constraints are almost equally prominent in farmers' assessments. The result highlights an important distinction between a low price and an uncertain price. Low output prices reduce expected profitability, whereas price volatility increases uncertainty of production profitability. Farmers therefore face a double commercialisation problem: they may receive prices they consider inadequate, while also being uncertain about whether prices will improve sufficiently to justify postponing sales. This finding is supported by Cardell (2023), who demonstrates that maize prices in many African markets fluctuate substantially between harvest and lean seasons.

However, poor roads were ranked fourth, with a mean rank of 3.892. This implies that poor feeder roads increase transaction costs in transporting produce to markets. The problem becomes particularly important for farmers located in remote communities. Abdulai et al. (2020) similarly identified poor road networks affecting smallholder farmers' access to markets in northern Ghana. The present finding therefore supports the argument that improving rural roads can reduce the spatial transaction costs associated with commercialisation.

Nevertheless, about 20% of farmers identified lack of storage as a constraint, giving it a mean rank of 2.884. This relatively low ranking contrasts with the widespread assumption that inadequate storage is one of the principal constraints to maize marketing in northern Ghana. The result implies that farmers may have the alternative of selling soon after harvest because the financial need for immediate cash outweighs the expected benefits of holding maize. This

interpretation is consistent with Cardell (2023), who shows that farmers' reluctance to store maize is not explained only by a lack of storage facilities. Price uncertainty itself can make storage risky because higher future prices are not guaranteed.

Poor market information was identified as the sixth rank with a mean rank of 2.408. The findings agree with Morton and Martey (2021), who found that access to market information increased both the likelihood and intensity of maize market participation in the Savannah and Northern regions of Ghana. Similarly, Iddrisu et al. (2025) found crop-market information to be an important determinant of market participation intensity among smallholder farmers in northern Ghana. The low percentage should not be interpreted as evidence that market information is irrelevant. Instead, it may indicate that the quantity of information is less problematic than its quality and usability.

The results further show that none of the farmers reported high transportation costs as a market constraint, with the lowest mean rank of 2.184. This finding is contrary to Mzyece et al. (2023), who found substantial differences in transport costs between farmers selling directly to consumers and those selling through aggregators. However, the difference may be explained by the marketing structure of the farmers in the study area. If farmers commonly sell maize to traders, aggregators or other buyers who collect produce near the farm gate, farmers may not perceive transport expenditure as a direct constraint even though transportation remains an important cost within the value chain.

Determinants of Maize Commercialisation Intensity

The study considered the fractional logit model because the Market Commercialisation Index (MCI) is a fractional outcome. Robust standard errors were used to account for unequal error variances. Using 125 observations, the model showed acceptable fit (McFadden pseudo-R^2 = 0.093) with no serious dispersion problems. VIF values (1.09 - 7.65) indicated no major multicollinearity (see details in Appendix). OLS tests showed heteroskedasticity and possible functional-form problems, further supporting the fractional logit specification for modelling MCI. The results in Table 5 show a statistically significant negative association of gender with maize commercialisation intensity. The marginal effect indicates that male farmers have a maize commercialisation intensity approximately 15.6 percentage points lower than female farmers. This finding is noteworthy because male farmers are commonly expected to have greater access to land, productive assets and financial resources. However, the negative gender effect is consistent with Abdallah et al. (2021), who reported that commercialisation was negatively associated with the gender of the farm household head in the Northern region. Similarly, evidence from Effutu Municipality found that male farmers had lower commercialisation intensity than female farmers, despite the expectation that men would have superior access to productive resources.

Table 5: Results of Maize Farmers' Commercialisation Intensity

Variable	Coefficient	Marginal Effect	Robust Standard Error	Z-Value
Age (years)	0.001	0.013	0.012	1.08
Gender (dummy)	-0.69	-0.1560***	0.207	-3.37
Farming experience (years)	-0.042	-0.0095***	0.012	-4.17
Education (dummy)	0.316	0.0730**	0.184	2.28

Household size (number)	0.01	0.0023*	0.008	1.8
Maize area cultivated (acres)	0.061	0.0139**	0.011	2.42
Distance to maize market (km)	-0.08	-0.0182*	0.055	-1.66
Transportation cost (GHS)	-0.018	0.0041***	0.003	-7.42
Access to credit (dummy)	-0.421	-0.0981***	0.102	-3.34
Market information (dummy)	0.717	0.1599***	0.188	5.4
Constant	0.875	—		—

Source: Authors' Analyses, 2026 Model: Fractional logit; $N = 125$; HC3 robust SE. McFadden pseudo-$R^2 = 0.092$; deviance = 11.30; Pearson $\chi^2 = 9.08$.

Farming experience is negatively associated with commercialisation intensity. The marginal effect implies that an additional year of farming experience is associated with approximately a 0.95-percentage-point reduction in the share of maize output marketed, holding other factors constant. Experienced farmers may have developed production and consumption strategies oriented toward household food security, storage and risk management rather than maximizing the share of output sold. This implies that farm experience may help a farmer decide whether to participate in a market, while simultaneously encouraging more conservative post-harvest behaviour once participation has occurred.

Education has a positive and statistically significant relationship with commercialisation intensity. Educated farmers, on average, had a 7.3-percentage-point higher commercialisation intensity than farmers without education, ceteris paribus. Education can improve farmers' ability to interpret market prices, evaluate buyers, negotiate transactions, understand contractual conditions and use market information. This is in line with Abdallah et al. (2021) who found that education increased the participation of maize farm households in the Northern region. However, this is contrary to Iddrisu et al. (2025), who found a marginally negative relationship between education and maize market participation of maize farmers in Northern Ghana.

Household size has a positive association with commercialisation intensity, and suggests that an additional household member is associated with about a 0.23-percentage-point increase in the proportion of maize marketed. A possible explanation is that larger households provide family labour that reduces dependence on hired labour and permits farmers to undertake more labour-intensive production, harvesting and post-harvest marketing activities. Iddrisu et al. (2025) found a positive relationship between household size and market participation intensity, arguing that household members can provide relatively inexpensive labour during production activities. Nevertheless, Abdallah et al. (2021) found a negative relationship between household size and maize commercialisation in Savelugu. This indicates that the effect of household size depends on whether additional household members primarily constitute a source of farm labour or additional consumers of maize.

Farm size has a positive and statistically significant effect on maize commercialisation intensity. This indicates that farmers tend to sell a greater proportion of their harvested output, ceteris paribus. The result is consistent with the marketable-surplus hypothesis, which posits that an expansion in productive land increases the potential volume of output available after satisfying household consumption. Consequently, farmers with larger maize farms are better positioned to generate sufficient surplus for commercial exchange. This is similar to Mzyece

et al. (2023), evidence that farm size significantly increased both the probability and intensity of maize market participation among smallholder farmers. The positive relationship can further be explained by economies of scale. Farmers operating larger maize farms can distribute certain fixed production and marketing costs over a greater quantity of output, thereby potentially reducing average production and marketing costs.

Distance to the nearest maize market has the expected negative relationship, implying that a one-unit increase in kilometer is associated with approximately a 1.82-percentage-point reduction in maize commercialisation intensity. The negative direction is economically intuitive. Greater distance raises the time and financial costs associated with selling maize, reduces access to alternative buyers and may expose farmers to greater risks of price uncertainty. Farmers located farther from markets may consequently retain a larger proportion of their maize for household consumption or sell through nearby traders rather than transporting larger quantities to formal markets.

Their results also imply that intermediary or aggregator markets can reduce both pecuniary and non-pecuniary marketing costs. Similarly, Mzyece et al. (2023) found that distance and transportation costs differed substantially across maize marketing channels and that farmers selling directly to consumers incurred substantially higher transportation costs than farmers selling to aggregators.

Transportation cost also had a negative and statistically significant effect on maize commercialisation intensity. The marginal effect indicates that an increase in transportation cost results in 0.41 percentage point reduction in the proportion of harvested maize that farmers sell in the market, ceteris paribus. The negative relationship is especially relevant when considering northern Ghana. Especially, where smallholder farmers tend to be located in rural communities with poor feeder roads, long distances to major markets and limited access to affordable transport services. Iddrisu et al. (2025) emphasised that transaction costs and limited market access are important constraints to smallholder market participation. Also, Konja and Mabe (2023) identified distance to the output market and access to transport among the important determinants of both market participation and participation intensity. Thus, this finding is consistent with a wider pattern in which physical market-access constraints reduce the intensity of smallholder commercialisation in Northern Ghana.

Access to credit has approximately a 9.8-percentage-point lower maize commercialisation intensity than that of otherwise comparable farmers without credit access. This finding is contrary to the conventional expectation that credit relaxes liquidity constraints and enables farmers to purchase inputs and and produce a larger marketable surplus. It nevertheless has several possible explanations. First, credit may be used for purposes other than expanding market-oriented maize production, including household consumption, debt repayment, non-farm activities or other agricultural enterprises. Second, farmers who access credit may face repayment obligations that induce them to sell maize relatively early or in response to liquidity needs, while simultaneously retaining other output for food security. The finding should therefore be interpreted as a conditional association rather than evidence that agricultural credit is disadvantageous to commercialisation.

Access to market information positively determines commercialisation intensity in the model. The results show that farmers with access to market information have approximately a 16.0 percentage-point higher commercialisation intensity than farmers without access to market information. This result provides strong evidence that information constraints constitute an important barrier to agricultural commercialisation. Market information can reduce uncertainty

about prevailing prices, improve farmers' bargaining position, facilitate comparison among buyers and enable farmers to identify profitable marketing periods and outlets.

The finding is consistent with Morton and Martey (2021), who showed that farmers with better access to market information were more likely to participate in maize markets with higher returns. Similarly, Mzyece et al. (2023) noted that access to information had a significant positive effect on the quantity of maize sold by participating farmers.

CONCLUSION

The study evaluated the level of maize commercialisation, factors influencing commercialisation intensity and key constraints faced by smallholder maize farmers in Tolon District of Northern Ghana. The results show a mean Household Maize Commercialisation Index (HMCI) of 52.5%. This shows that farmers sold a little over half of the harvested maize and kept the rest for home consumption, gifts or other purposes. The distribution reflects considerable heterogeneity in farmers' participation in maize markets and suggests that increased production may not necessarily translate into increased market orientation. Rather, the decision of farmers to commercialise depends on the profitability, accessibility, predictability and transaction costs of output markets.

The constraint analysis reinforces this interpretation with Kendall's coefficient of concordance showing a relatively strong degree of agreement among farmers concerning the severity of the constraints. Low output prices ranked first, followed by high production costs and price fluctuations. Poor road infrastructure occupied the fourth position, while inadequate storage, poor market information and transportation costs received progressively lower mean ranks. The prominence of output prices and production costs indicates that farmers' commercialisation decisions are strongly connected to expected net returns rather than simply the availability of markets.

The fractional logit estimates further show that commercialisation intensity is associated with a combination of farmer, household, farm and market-access characteristics. Gender, farming experience, distance to market, transportation costs and access to credit were negatively associated with commercialisation intensity. Education, household size, maize area cultivated and access to market information were positively associated with the proportion of maize marketed.

The negative association between distance to market, credit access and transportation costs highlights the importance of transaction costs in determining commercialisation intensity. However, the negative association between credit access and commercialisation does not necessarily imply that credit reduces commercialisation but should be understood as a conditional association rather than a causal effect.

The findings suggest that policy should move beyond a narrow emphasis on increasing maize production and instead address the profitability and efficiency of commercialisation. First, mechanisms that improve output-price transparency and strengthen farmers' bargaining position should be promoted. Farmer-based organizations and producer groups can facilitate collective marketing, aggregation and negotiation with traders and institutional buyers.

Second, interventions should address the high cost of maize production. Improved access to quality seed, fertilizer, and labour-saving technologies can reduce unit production costs and improve the profitability of marketed surpluses. Such interventions should be complemented

by efforts to strengthen access to appropriate financial services rather than simply expanding the volume of credit available

The constraints of farmers' commercialisation intensity should address issues such as promoting mobile-phone-based price information, extension messaging, and digital market platforms. These could provide farmers with timely information about prevailing prices, potential buyers, demand conditions and appropriate marketing periods. Also, the government should prioritise investment in rural roads and transport infrastructure. Because poor roads increase the time and monetary costs of moving maize from the communities to markets and may weaken farmers' access to competitive buyers.

Although transportation cost received the lowest mean constraint rank, its significant negative association with commercialisation intensity indicates that transport costs may operate indirectly through traders, aggregators and marketing channels.

Finally, agricultural extension should increasingly incorporate commercialisation-oriented services. Extension services programmes should not focus exclusively on production technologies but also provide training in farm business, price negotiation, post-harvest management and informal market research and planning. Gender-responsive approaches should be considered because the observed negative association between males and commercialisation intensity suggests that commercialisation strategies may need to recognise differences in household responsibilities and marketing decisions.

However, given the study's cross-sectional design, the estimated relationships should be interpreted as associations rather than definitive causal effects. The study is further limited by respondents selected from maize sellers only; findings may not represent non-sellers or farmers elsewhere. Self-reported data may contain recall or reporting errors. In addition, the sample size and HMCI measure limit subgroup analysis and assessment of maize sales profitability. However, future studies using panel data or stronger identification strategies could further examine the causal effects of market information, credit, infrastructure and collective marketing on commercialisation intensity.

Declarations

Author Contributions

Conceptualization, YA[3], AI; Data acquisition, YA[3]; Analysis and interpretation, AI, YA; Supervision, AI, YA; Writing – original draft, YA[3]; Manuscript review and editing, AI, YA. The paper is based on YA[3]'s Bachelor of Technology thesis, supervised by AI and YA. All authors read and agreed to the final version of the manuscript.

Funding

No funding was received

Ethical Approval

Not applicable

Informed Consent

All conditions were written and read to the respondents. This particularly applied to farmers who were not literate, while those who were literate were provided with a copy of the consent

form or it was read to their understanding before the interviews. All participants therefore consented to participate.

Data Availability

The authors confirm that the data supporting the findings of this study are available and will be shared upon request.

Competing Interest

There is no competing interest whatsoever associated with this manuscript.

Acknowledgement

Not applicable

Generative AI and AI- Assisted Technologies

Conceptual framework Figure 1. generated by AI

REFERENCES

Abdallah, S., Alhassan, H., Donkoh, S. A., & Appiah-Adje, C. (2021). Participation in Planting for Food and Jobs programme and commercialisation among maize farm households in Savelugu Municipality, Ghana. *Ghana Journal of Development Studies, 18*(2), 1–24. doi:10.4314/gjds.v18i2.1.

Abdulai, A., Osei-Amponsah, C., & Jumpah, E. T. (2020). Analysing the determinants, constraints and opportunities of smallholder farmers' access to input markets: Evidence from northern Ghana. *Journal of Agribusiness and Rural Development, 56*(2), 133143. doi:10.17306/J.JARD.2020.01286

Abu, B. M., Sarpong, D. B., Osei-Asare, Y. B., Okyere, C. Y., & Kim, T. (2024). Determinants of an extended metric of agricultural commercialisation in Ghana. *Scientific African, 26*, e02412. doi:10.1016/j.sciaf.2024.e02412

Barrett, C. B. (2008). Smallholder market participation: Concepts and evidence from eastern and southern Africa. *Food Policy, 33*(4), 299–317. doi:10.1016/j.foodpol.2007.10.005

Cardell, L. (2023). Price risk and small farmer maize storage in Sub-Saharan Africa: New insights into a long-standing puzzle. *American Journal of Agricultural Economics, 105*(3), 737-759. doi:10.1111/ajae.12343

Ghana Statistical Service. (2021). *2021 population and housing census*. Ghana Statistical Service.

Iddrisu, A., Nkegbe, P. K., & Mabe, F. N. (2025). Market participation intensity of smallholder farmers in the Northern Region of Ghana. *Discover Agriculture, 3*(1), 1–21. doi:10.1007/s44279-025-00417-y.

Julius, M., Mshenga, J., & Khororo, T. (2022). Impact of agricultural market commercialization on the economic welfare of rural households. *Agriculture & Food Security*, *11*(1), 45 58.

Key, N., Sadoulet, E., & de Janvry, A. (2000). Transactions costs and agricultural household supply response. *American Journal of Agricultural Economics, 82*(2), 245–259. doi:10.1111/0002-9092.00022

Konja, D. T., & Abdulai, A. (2024). Collective market action, farm performance, and household welfare among maize farmers: The role of outgrower scheme in Northern Ghana. *Applied Economics, 57*(35), 5410–5426. doi:10.1080/00036846.2024.2364927

Konja, D. T., & Mabe, F. N. (2023). Market participation of smallholder groundnut farmers in Northern Ghana: Generalised double-hurdle model approach. *Cogent Economics & Finance, 11*(1), 2202049. doi:10.1080/23322039.2023.2202049.

Li, M., Wang, J., & Qu, M. (2023). Does market participation facilitate agricultural productivity and household welfare? Evidence from smallholders. *Food Policy*, *115*, Article 102412.

Ministry of Food and Agriculture [MoFA]. (2024). *Agriculture in Ghana: Facts and figures 2024*. Statistics, Research and Information Directorate, Ministry of Food and Agriculture.

Morton, G., & Martey, E. (2021). Market information and maize commercialisation in the Savannah and Northern regions of Ghana. *Scientific African, 13*, e00938. doi:10.1016/j.sciaf.2021.e00938

Mzyece, A., Shanoyan, A., Amanor-Boadu, V., Zereyesus, Y. A., Ross, K., & Ng'ombe, J. N. (2023).How does who-you-sell-to affect your extent of market participation? Evidence from smallholder maize farmers in Northern Ghana. *Cogent Economics & Finance, 11*(1), 2184062. doi:10.1080/23322039.2023.2184062.

Papke, L. E., & Wooldridge, J. M. (1996). Econometric methods for fractional response variables with an application to 401(k) plan participation rates. *Journal of Applied Econometrics, 11*(6),619–632. doi:10.1002/(SICI)10991255(199611)11:6<619::AIDJAE418>3.0.CO;2-1

Singh, I., Squire, L., & Strauss, J. (Eds.). (1986). *Agricultural household models: Extensions, applications, and policy*. Johns Hopkins University Press.

Von Braun, J., & Kennedy, E. T. (Eds.). (1994). *Agricultural commercialisation, economic development, and nutrition*. Johns Hopkins University Press.

Williamson, O. E. (1985). *The economic institutions of capitalism: Firms, markets, relational contracting*. Free Press.

APPENDIX

Multicollinearity Diagnostic Test Results

Explanatory variable	VIF	Tolerance
Age	7.61	0.131
Gender	1.804	0.554
Farming experience	5.914	0.169
Education	2.982	0.335
Household size	1.69	0.592
Maize farm size	7.483	0.134
Distance to market	1.364	0.733
Transportation cost	3.501	0.286
Access to credit	1.679	0.595
Market information	1.085	0.921
Mean VIF	3.511	

Source: Authors' Analyses, 2026