

Distributional effects of non-farm income on farm income and household welfare: Evidence from rural Ghana

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Abstract

The study examines the impact of non-farm income on farm income across the income distribution of rural households in Ghana, as well as its effect on poverty incidence. Data were obtained from the 7th Round of the Ghana Living Standards Survey. Quantile and probit regression models with instrumental variables were employed to achieve the study's objectives. Quantile regression results show that non-farm income helps stabilize farm income but is less effective for the poorest households. A one-unit increase in non-farm income raises rural farm income by 14.2 percentage points ($p < 0.05$) at the 50th quantile and 14.7 percentage points ($p < 0.05$) at the 75th quantile but has no significant effect at the 25th quantile. The probit regression further reveals that non-farm participation reduces poverty, but this only holds for households in the lower half of the income distribution. Our findings underscore the need for complementary economic activities for improving the livelihoods of rural populations. It also calls for a review of the land tenure system, which the study identified as having adverse effect on the poorest households. This study provides new insights into the impact of rural non-farm activities on agricultural households, detailing their role in alleviating poverty across the income distribution.

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Introduction

Despite significant progress in poverty alleviation in Ghana, rural households continue to experience substantial poverty, as most rely heavily on agriculture (Bonye et al., 2020; Okoh & Hilson, 2011; Brown et al., 2023). Statistical data on poverty trends in Ghana show that rural communities are disadvantaged compared to urban areas due to limited employment opportunities and unpredictable weather patterns, which severely affect their predominantly agricultural livelihoods (Ghana Statistical Service [GSS], 2020; Zereyesus et al., 2016; Wang et al., 2020). To cope, many individuals in rural Ghana have abandoned agricultural work, migrating to cities or pursuing alternative income-generating activities (GSS, 2020).

Governments in many developing countries have implemented various interventions to safeguard the well-being of rural farm households. Ghana, for example, introduced the agricultural inputs and support mechanisms (Zereyesus et al., 2016). Others have relied on 'climate-smart' production technologies such as heat- and drought-resistant seed varieties, conservation agriculture, crop and varietal diversification, and soil and water management (Ariom et al., 2022; Voss, 2022). However, according to the United Nations Development Programme (2021), many such interventions have been unsustainable due to their temporary nature. Additionally, bureaucratic obstacles in identifying eligible beneficiaries, uncertainties in implementation, and the lack of succession plans after these programmes end further undermine their overall effectiveness (UNDP, 2021). This situation compels rural farmers to explore alternative income-generating options, such as non-farm diversification, to cushion them against the erratic effects of fluctuating on-farm income (Yaro, 2013).

Engaging in non-farm activities in addition to farming is a characteristic feature of rural households in Ghana. While the overall non-farm participation rate stands at 53.2% in Ghana (Senadza, 2012), studies put the proportion of rural farm households engaged in non-farm income-generating activities in Ghana at 42.9% (Dary & Kuunibe, 2012). Recent evidence from the Ghana Living Standards Survey Round 7 (GLSS7) puts rural households' engagement in non-farm activities at about 55 percent with participation intensity ranging from seasonal engagement to full-year involvement (GSS, 2019). These activities include petty trading, transport services, artisanal work, small-scale manufacturing, as well as more skill-intensive wage employment such as teaching and security services (GSS, 2019). These demand skills vary from informal education to vocational skills and relative higher education (GSS, 2019; Nagler & Naudé, 2017; Owusu & Abdulai, 2019).

This significant involvement prompts important questions about rural non-farm activities. To what extent do non-farm income activities impact rural farm incomes in Ghana? Is the impact constant across incomes, or does it vary along the income distribution? Furthermore, although the question of how non-farm income affects rural welfare and poverty has been widely researched, recent structural changes in rural labour

markets, rising climate-related risks, and shifts in informal sector opportunities provide new motivation to re-examine this issue using the most recent GLSS data. Answering these questions would help design rural development policies that maximize the impact of non-farm activities on rural households.

Numerous studies have examined the role of non-farm activities on rural household welfare and poverty (Senadza et al., 2018; Senadza, 2012; Senadza, 2011; Anang & Yeboah, 2019; Owusu & Abdulai, 2019; Adekunle et al., 2020; Bukar et al., 2018; Anang, 2017). However, these studies often overlook how non-farm income contributes to the stabilization of farm incomes and how it affects poverty outcomes among farming households at different points in the income distribution. For instance, Ba et al. (2021), studying rural households in Mauritania, found that those engaged in non-farm activities were 5.9 percentage points less likely to fall below the poverty line, and they reported significant reductions in both poverty gap (3.6%) and poverty intensity (1.9%). While these findings highlight the crucial role of non-farm activities in poverty alleviation, they do not explore differential poverty-reducing impacts across various income groups, or the role non-farm income plays in mitigating fluctuations in farm income. Similar gaps exist in studies conducted in Ecuador (Lanjouw, 1998), China (De Janvry et al., 2005), India (Lanjouw & Murgai, 2009), and Ghana (Senadza, 2011; Senadza et al., 2018), which confirm the poverty-reducing benefits of non-farm activities without examining differential impacts. The present study addresses these research gaps by examining how non-farm income affects farm income across the income distribution of rural households in Ghana and how it influences poverty incidence. This will help identify which rural households benefit most from non-farm income and which do not. The evidence from the study is expected to help policymakers design more targeted and effective livelihood programmes in rural communities, aimed at promoting non-farm activities as means of improving household welfare and addressing rural poverty.

Literature review

The intertwining dynamics between non-farm economic activities and poverty reduction in rural settings reveal a multifaceted relationship that goes beyond mere financial transactions. Non-farm activities act as a financial cushion for rural households that engage in on-farm work, offering a remedy to the financial hurdles associated with obtaining credit for agricultural ventures. In the absence of established financial structures and collateral, farmers often find it difficult to secure loans for crucial on-farm investments. The revenue generated from non-farm work serves as a pragmatic solution, providing the necessary funds to enhance agricultural production and overcome financial barriers (Neglo et al., 2021; Ba et al., 2021). In essence, non-farm activities emerge as indispensable safety nets for rural households, filling the void left by the absence of traditional financial savings (Fuseini, 2018).

Moreover, the integration of non-farm pursuits into the rural landscape also creates a ripple effect that extends beyond immediate financial gains. During off-seasons or lulls

in on-farm activities, non-farm employment opportunities become a lifeline for rural households, contributing significantly to income generation. This additional income serves as a versatile resource, not only fuelling further investments in on-farm activities but also addressing fundamental family needs such as education and consumption (Escobar et al., 2001). The ability to diversify income sources becomes crucial in shielding rural households from the impact of unforeseen events, such as natural disasters, ensuring a more resilient economic foundation (Alobo-Loison, 2015). It is also evident that, the employability, revenue generation potential, and safety net features of non-farm activities collectively contribute to minimizing the fluctuations in rural household farm incomes and, consequently, reducing poverty among those who complement their on-farm activities with diverse economic pursuits (Ba et al., 2021; Senadza et al., 2018).

There is a positive correlation between engagement in non-farm activities and increased farm productivity in the form of its ability to heighten investments in agricultural inputs, modern technology, and the hiring of extension officers (Dedehouanou et al., 2018). Furthermore, the financial gains from non-farm activities empower farmers to adopt sustainable agricultural practices, such as investing in drought-resistant crops, seeds, and irrigation (Dedehouanou et al., 2018). This transformative capability addresses historical constraints that impoverished farmers faced, thereby contributing to a significant upswing in both crop and livestock production (Neglo et al., 2021).

While much of the literature focuses on non-farm income supporting on-farm activities, studies also show a reverse relationship where farm income plays a crucial role in establishing and sustaining non-farm enterprises (Danso-Abbeam et al., 2020). Farm earnings and products are frequently reinvested in petty trading, agro-processing, transportation services, and artisanal activities, particularly in contexts characterized by underdeveloped rural credit markets (Barrett et al., 2001; Haggblade et al., 2010; Danso-Abbeam et al., 2020). In this regard, income from farming serves as a critical source of start-up capital for non-farm businesses, relaxing liquidity constraints and enabling households to overcome entry barriers into off-farm activities. Beyond capital provision, the literature further suggests that farm income serves as an informal insurance mechanism, mitigating the risks associated with experimenting and uncertainty in non-farm enterprises by sustaining such activities during periods of low profitability (Danso-Abbeam et al., 2020). Reardon et al. (2007) also highlight the role of farm income in scaling up off-farm economic ventures, as well as in enhancing their productivity and quality. Additionally, evidence indicates that the flow of income between farm and non-farm sectors is bidirectional (Haggblade et al., 2010). While a portion of farm income is typically allocated to expanding or maintaining non-farm ventures, a substantial proportion of about 30% and 60% of non-farm income are reinvested in farm inputs, equipment, or labour etc. (Reardon et al., 2007).

There is also significant impact of non-farm activities on reducing poverty in rural areas especially when one considers various aspects of household welfare, including access to food, education, healthcare, housing, basic services, and financial stability. For instance,

a study conducted by Zereyesus et al. (2016) focused on northern Ghana and found that engaging in non-farm work helped rural households cope better averting threats of food insecurity. Using the Feasible Generalised Least Squares (FGLS) estimator, the study showed that participating in non-farm work significantly increased households' ability to access food in the future, thus reducing the risk of food poverty. Similarly, Imai et al. (2015) for China and India highlighted the protective role of non-farm activities on rural economic well-being. They found that individuals engaged in non-farm work were less vulnerable to future financial uncertainties compared to those solely reliant on farming. In other words, non-farm activities provided a more stable income outlook, offering a buffer against poverty. This is further supported by Pham et al. (2021), particularly in non-monetary aspects such as housing and asset ownership, where the benefit of non-farm work was more pronounced, enabling such households to easily acquire properties.

Despite the potential safety net provided by non-farm activities in enhancing farm incomes and reducing the vulnerability to poverty of rural farm households, it is not a guaranteed solution for the poorest rural households due to various barriers to entry. Imai et al. (2015) suggests that the level of protection offered by non-farm work depends on the skills involved, with those engaged in skilled non-farm activities facing lower risks of future poverty than those in unskilled or manual roles. Consequently, participation in non-farm work presents challenges, with education and skills playing a crucial role in determining the type of activities available to rural households. Individuals with at least a secondary education are more likely to access skilled non-farm opportunities (Imai et al., 2015; Knight et al., 2010). Moreover, the poorest rural households may find it difficult to engage in non-farm activities due to potential malnutrition issues, which can negatively impact their ability to develop skills (Imai et al., 2015; Sharma & Singh, 2019). While non-farm ventures may not require significant capital investment, even modest financial requirements can pose a challenge for extremely poor households. Additionally, limited access to markets and networking opportunities can hinder the realization of the safety net benefits associated with non-farm activities (Sani, 2017). From the foregoing, it is evident that rural households may not benefit equally from non-farm activities. In other words, its impact on farm income and poverty may differ along the income distribution. The novelty of this paper is in ascertaining the impact of non-farm activities on rural households' farm income and vulnerability to poverty across the income distribution, thus filling an important gap in the literature.

Theoretical framework

Two theoretical perspectives are used to explain rural households' choices of selecting non-farm activities in addition to their already existing livelihood of farming activities. The Agricultural Household Model (AHM) and the Livelihood Diversification (LD) Theory explain livelihood choices under market imperfections of access to credit and institutional support for rural economic activities. The Agricultural Household Model

(AHM) developed by Singh, Squire, & Strauss (1986) posits that when credit, labour, and insurance markets fail, as is common in rural Ghana, households are expected to behave as both producers and consumers in their decision making. They engage in both farm and non-farm activities and allocate their labour and other resources to maximise their overall welfare. According to the AHM, households compensate for limited access to credit or formal insurance by using income from non-farm activities as a self-insurance mechanism. This enables them to finance agricultural inputs, hire labour, purchase modern technology, and withstand shocks such as price fluctuations or climatic variability. Studies such as Nkegbe (2022) validate these propositions by identifying that non-farm income enhances on-farm activities by easing liquidity constraints among rural households in West Africa. Similarly, Anang (2020a) show that Ghanaian farm households rely heavily on non-farm earnings to support farming investments, particularly where financial markets are inaccessible.

The Livelihood Diversification (LD) Theory developed by Ellis (2000), on the other hand, posits that rural households engage in different income-generating activities as a strategy to reduce risk, accumulate assets, and improve resilience. Thus, instead of relying solely on farming, households also participate in non-farm activities either as a survival strategy to cope with economic hardship and income instability, or as an accumulation strategy aimed at expanding economic opportunities beyond agriculture. Evidence from Aloba-Loison (2015) and Mohammed et al. (2021) reinforces these ideas as they demonstrated that livelihood diversification significantly enhances welfare and reduces vulnerability among rural farm households.

Together, while the AHM explains how non-farm income can serve as a safety net and financial buffer that stabilises and enhances farm income, the LD Theory on the other hand explains why rural households diversify and how such diversification affects welfare outcomes, including vulnerability to poverty.

Conceptual framework

In Figure 1, we present a conceptual framework illustrating the intricate connections between on-farm and non-farm economic activities within rural communities, highlighting their pivotal role in mitigating the vulnerability of households' dependence on on-farm income. This framework recognizes various factors that influence the adoption of non-farm activities, including income levels, education, and skills (Asravor, 2020; Sienso et al., 2015). However, it begins with the fundamental notion that rural farmers engage in non-farm activities for various reasons, including to supplement unstable on-farm income, to boost on-farm activities in the face of limited access to commercial capital, or to diversify income amidst the uncertainties of agricultural production.

At the heart of the model lies the acknowledgment that on-farm activities constitute the primary economic pursuit for rural dwellers (Anang et al., 2020b), yet challenges such as low productivity due to adverse climatic conditions, constrained investment

opportunities, or inadequate skills may predispose rural communities to poverty (Asravor, 2020). Consequently, individuals may seek economic alternatives in urban areas or turn to non-farm activities for sustenance (Azumah & Ahmed, 2023). The involvement of rural dwellers in non-farm activities, especially those predominantly engaged in on-farm tasks, serves a dual purpose; firstly, to serve as a buffer against income shortfalls and mitigate vulnerability to poverty (Tsiboe et al., 2016), and secondly, to channel earnings from non-farm endeavours back into on-farm activities for higher productivity (Mollers & Buchenrieder, 2005). This underscores the importance of viewing on-farm and non-farm activities as complementary rather than competing sources of income (Kusters, 2010). Furthermore, the participation of rural households in non-farm activities serves as a safety net against poverty, ensuring a minimum level of income for the household, thereby preventing them from falling below the poverty threshold (Ravallion et al., 2008). The interdependence between on-farm and non-farm activities manifests in forward and backward linkages, where outputs from on-farm activities serve as inputs for non-farm endeavours, and vice versa. This symbiotic relationship presents opportunities for market access, financial resources, and overall economic improvement.

In conclusion, the framework suggests that the mitigation of vulnerability stemming from on-farm activities is facilitated by the investment potential enabled by backward linkages with the non-farm sector. Moreover, the combined efficacy of on-farm and non-farm activities sustains employability and serves as a robust revenue generation mechanism resilient to climatic conditions, thereby reducing rural communities' susceptibility to poverty.

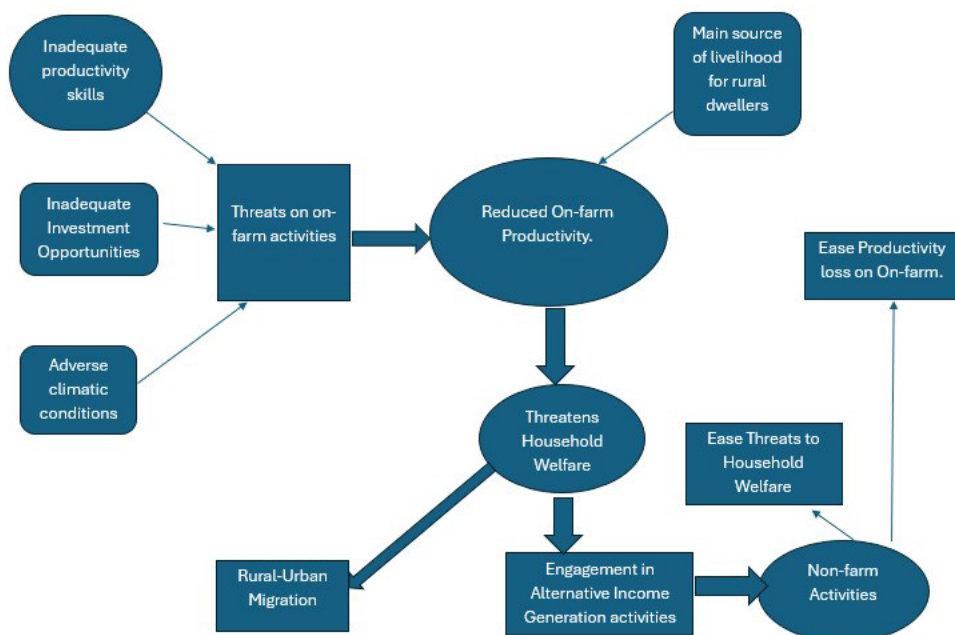


Figure 1: Conceptual framework of the linkage between Rural On-farm and Non-farm Economic Activities

Methods

Empirical model

In line with the conceptual framework guiding this study, we examine the effect of non-farm income on on-farm income. We acknowledge that funding to support on-farm could be obtained from other sources. To incorporate all these, the study limits itself to the value of the credit facility obtained. To reduce potential omitted-variable bias, the analysis also incorporates key household and farm-level control variables in line with the off-farm literature. Education of the household head captures human capital and managerial capacity, as household heads typically make primary farm management decisions in rural Ghana (Danso-Abbeam et al., 2020). Household size accounts for labour availability and dependency pressures. Control variables like educational level, the size of farmland, the proportion of farm produce that goes to the household (i.e., crop share ratio) and the harvested area of the farm are also incorporated. Harvested area and total farmland size serve as proxies for production scale and farm capacity (Senadza et al., 2018; Senadza, 2012). The crop share ratio variable captures informal or formal land agreements between farmers and landowners, indicating the share of crops that the household can keep for consumption or sale. This variable reflects customary land tenure arrangements that influence production incentives and income realization (Barrett et al., 2001). Access to credit is included to account for liquidity constraints that may simultaneously affect farm income and engagement in non-farm activities (Reardon et al., 2007; Haggblade et al., 2010). All demographic variables in our study, including sex, refer to the household head, unless otherwise stated. Restricting the analysis to rural farming households helps control for spatial heterogeneity. Although factors such as soil quality, localized climatic shocks, farmer skill, and market access are unobserved, an instrumental variable strategy is employed to mitigate bias arising from unobserved heterogeneity and potential reverse causality. “Years engaged in non-farm activities” is excluded from the farm-income specification to avoid post-treatment bias, as it directly predicts non-farm income.

The model to be estimated is stated as follows:

$$YOF = \alpha + \beta_1 YNF + \beta_2 Fcredit + \beta_3 Edu + \beta_4 HH_{size} + \beta_5 Crop_{ratio} + \beta_6 H_{area} + \beta_7 Sex + \varepsilon \quad (1)$$

Where *YOF* is on-farm income, *YNF* is the non-farm income, *Fcredit* represents value of credit facilities. These are scaled into units of 10,000 cedis. *Edu*, represents the education of household head in years of schooling, and *HH_{size}* represents household size. The level of education of the household head is used because they represent the primary decision-makers in farm management in rural communities (GSS, 2019). *Crop_{ratio}* represents the proportion of crops or farm produce that goes to the household, *Sex* is the gender of the household head and *H_{area}* is the harvested area of the farm (in hectares). In achieving our first objective, equation (1) is estimated by instrumented variable quantile regression due to its advantage of disaggregating the impacts at different wealth or income levels while dealing with potential endogeneity problems. The instrumental variable

was carefully selected to ensure the validity and reliability of the result estimates. It is essential that this variable meets the criterion for the existence of endogeneity among the explanatory variables. Specifically, the instrumental variable should be correlated with the endogenous variables but not correlated with the error term in equation (1). This was validated using the Sargan overidentification tests and the F-test for the relevance of the instrument (Stock & Watson, 2018; Dougherty, 2011).

To address the second objective of the paper, two level estimations are made. The first is the effect of participation in non-farm activity on poverty incidence. We use the instrumented probit regression in this case where the dependent variable “ $V_{poverty}$ ” was coded as a dichotomous variable “zero” as non-poor and “one” as poor. Second, we estimate the impact of non-farm income on poverty alleviation at different income quantiles. We estimate the following equation.

$$V_{poverty} = predicted(NF_{income}) + Edu + HH_{size} + NF_{years} + NF_{credit} + Sex + \varepsilon \quad (2)$$

Where $V_{poverty}$ represents poverty incidence (i.e. headcount), $predicted(NF_{income})$ which is our instrumented variable, where non-farm skilled labour and nature of non-farm work are used as instruments for non-farm income. Edu is education of household head in years, HH_{size} represents household size and NF_{years} number of years engaged in non-farm work. Due to the limitations of Stata 17 in estimating instrumented quantile regression, we utilized an instrumental variable two-stage least squares (IV) estimator for our instrumented equation (i.e., IV 2SLS). Our instrumental variable, non-farm income, is defined as follows:

$$YNF = \beta_0 + \beta_1 (nf_{workstatusnum}) + \beta_2 (NF_{skilledlabour}) + \varepsilon \quad (3)$$

where $nf_{workstatusnum}$ refers to the type of non-farm work engagement by rural households, which may include temporary part-time, temporary regular, permanent part-time, or permanent regular employment, and $NF_{skilledlabour}$ refers to non-farm skilled labour. The choice of instruments - type of non-farm work and non-farm skilled labour - reflects structural determinants of non-farm income because these are not directly linked to on-farm income. The type of non-farm work (temporary versus permanent; part-time versus full-time) does strongly influences wage levels, job stability, and earning capacity, making it a natural predictor of non-farm income but remains independent of farming activities. Similarly, possession of non-farm skills such as carpentry, tailoring, or masonry is typically acquired through long-term apprenticeship and enhances earning potential in the non-farm sector without directly determining farm output. Thus, our chosen instruments directly shape non-farm income but do not directly impact on-farm productivity, satisfying the exclusion restriction for the validity of our instrumentation. Results confirming the reliability and validity of the instrumental variable, as required by the two diagnostic tests, Sargan overidentification (chi-square of 0.158 ($p = 0.6913$)) indicating that the instruments are uncorrelated with the error term and the F-test for relevance ($F = 31.198$; $p < 0.001$), which showed that the instruments are valid and

reliable. Given the confirmed validity and reliability of the instrumented variable, it was incorporated into equations (1) and (2) to address potential endogeneity issues that could bias the results.

Data

The study utilized the 7th Round of the Ghana Living Standards Survey (GLSS 7) data of 2017. The data covers series of socio-economic variables but those of interest to this study were extracted for the analysis. While the Ghana Statistical Service (GSS) provides official lower and upper poverty lines for 2017, we computed our own poverty line to reflect household-level expenditures specific to the rural farming population, which is the focus of this study. The GSS poverty lines are designed for national-level assessments and include both urban and rural households, which may over- or under-estimate poverty incidence for rural farming households. This approach provides a tailored measure of poverty that aligns with the study's objective of analysing the impact of non-farm income on poverty among rural farm households. Following the primary objective of the study, the data were restricted to rural households who engage in farm activities. Thus, rural households not involved in farming activities were excluded from the study as means to control spatial variation across regions in Ghana. The computation of the poverty indices made use of the WDI data on the average exchange rate for Ghana in 2017 which was GHS4.34. We obtained a poverty line of GHS3011.29 and applied the Foster-Greer-Thorbecke (FGT) formula in generating the poverty headcount. The computed poverty line is broadly consistent with the GSS rural poverty thresholds, ensuring that the results are comparable with national standards while capturing the specific characteristics of our sample.

Results

Table 1 provides summary statistics of the restricted GLSS 7 dataset relevant to this study. It is evident that majority of rural household heads involved in farming are male, with an average formal education of 8 years. The average household size for rural farming households is approximately 5 people, ranging from 1 to 28. There is a considerable amount of land dedicated to farming, with an average size of 41 hectares. Most land agreements show a lower proportion of crop produce of about 1% going to the household head. The annual farm income averages GHS 3,841.495, while the income from non-farm economic activities is significantly higher, estimated at GHS 6,320.27 per year. Additionally, a family labour size of 2 is dedicated to farming activities compared to those engaged in non-farm activities of 1.

Table 1: Summary statistics of variables**Panel A**

Variable	Mean (n=4,432)	Std. Dev.	Min	Max
Non-farm income (GHS)	6,320.27	51,474.61	0	3,000,000
Farm income (GHS)	3,841.50	9,115.19	0	259,950
Household size	5.19	3.25	1	28
Farmland quantity (ha)	41.16	937.10	0	50,000
Land crop share ratio (%)	0.99	58.41	0	3,888
Non-farm family labour	0.08	0.425	0	7
Non-farm skilled labour	0.18	0.89	0	27
Farm family labour	1.66	3.02	0	27
Education of HH head (years)	7.77	3.35	0	19

Panel B

Variable	Category	Frequency	Percentage (%)
Sex of household head	Female	1,002	22.61
	Male	3,430	77.39
Poverty status of household	Non-poor	2,455	55.39
	Poor	1,078	24.32
	Very poor	899	20.28

Note: GHS = Ghanaian Cedis; ha = Hectares; HH = Household.

Table 2 presents the results of the effects of non-farm income on farm income and poverty among rural households. Panel A reports the quantile regression results of the impact of non-farm income on farm income. It is evident that while participation in non-farm activities enhances farm income, its impact is only significant for households at the upper half of the income distribution. Specifically, non-farm income enhances rural farm income by about 14.2 percentage points for middle-income (50th quantile) households and 14.7 percentage points for high-income (75th quantile). Therefore, while non-farm income can drive on-farm incomes, their impact is minimal among relatively poorer households, who may see only a negligible improvement in their farm incomes. Farmland size also plays a crucial role in determining on-farm income of households. Although the impact of farmland is significant across all income quantiles, it is stronger among lower-income households than among middle and high-income households, an indication of the extent to which their survival is dependent on the size of land available to them.

Except for high-income households, household size did not significantly impact on-farm income in rural communities. The findings also suggest that lower and middle-class rural households benefit more from education than their high-income counterparts

engaged in agriculture. Informal agreements between farmers and landowners regarding crop sharing have mixed impacts on on-farm income among rural households. For lower-class households, such agreements negatively affect their welfare, as on-farm income declines by 16.0 percentage points as their crop share increases. This counterintuitive result might be explained by the possibility that these households are economically unable to manage larger agreements effectively, in line with findings by Anang and Ayambila (2020c) who suggest that poorer households are limited to farming smaller land portions. Conversely, middle-class households benefit from such agreements, with on-farm income rising by 13.2 percentage points as their share increases. Regarding the impact of harvested area on rural households' on-farm income, the study establishes that this factor is significant only for high-income households, whose income rises by about 4.51 percentage points as the harvested area increases. Being a male head of household has a positive impact on on-farm income among lower and middle-class households, consistent with the findings of Atakli and Agbenyo (2020).

Panel B of Table 2 reports the probit model results of the likelihood of non-farm income on poverty incidence among rural households. The results show that non-farm income significantly reduces household poverty in rural communities. Specifically, participation in non-farm economic activities lowers the probability of poverty by 6.7 percentage points among rural households. The findings also indicate that poverty among rural farming households can be further reduced through improved education and access to credit facilities. In contrast, the use of family labour for non-farm economic activities had no significant impact on poverty incidence. Male-headed households have a higher probability of being vulnerable to poverty, suggesting that female engagement in non-farm economic activities has a significant poverty reducing role.

Table 2: Effects of Non-Farm Income on Farm Income and Poverty among Rural Households***Panel A: Quantile Regression Estimates of On-Farm Income***

	Q25	Q50	Q75
Non-farm income	0.101 (0.084)	0.142** (0.060)	0.147** (0.061)
Farmland	0.510*** (0.093)	0.360*** (0.066)	0.309*** (0.068)
Household size	0.102 (0.127)	0.120 (0.090)	0.256*** (0.093)
Education of HH head (years)	0.132*** (0.050)	0.112*** (0.036)	0.055 (0.037)
Credit	0.262 (0.210)	0.178 (0.149)	0.112 (0.154)
Crop sharing ratio	-0.160* (0.096)	0.132* (0.068)	0.102 (0.070)
Family farm labour	-0.066 (0.127)	-0.094 (0.090)	-0.229** (0.093)
Harvested area	0.018 (0.019)	0.013 (0.014)	0.045*** (0.014)
Male	0.453* (0.241)	0.366** (0.171)	0.168 (0.176)
Constant	3.440*** (0.697)	4.665*** (0.494)	6.022*** (0.511)
Observations	773	773	773

Panel B: Probit Estimates of Poverty Status

Variable	Coefficient	Marginal effects
Non-farm income	-0.197*** (0.027)	-0.067*** (0.009)
Household size	0.031 (0.053)	0.0105 (0.018)
Years engaged in NF	0.002 (0.005)	0.001 (0.002)
Education of HH head (years)	-0.182*** (0.021)	-0.0618*** (0.007)
Non-farm credit	-0.001** (0.000)	-0.001** (0.000)
Male	0.369*** (0.092)	0.125*** (0.031)
Constant	1.078*** (0.253)	
Observations	1,240	1,240
Pseudo R2	0.0992	

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Dependent variable in Panel A is annual farm income. 0.25 represents 25th quantile, 0.50 represents 50th quantile, 0.75 represents 75th quantile. Dependent variable in Panel B is poverty status. Years engaged in non-farm activities is excluded from Panel A because it predicts non-farm income itself and would therefore introduce post-treatment bias in estimating the effect of non-farm income on farm income.

In Table 3, we illustrate how non-farm income impacts poverty among rural households across different income distributions. By employing instrumented quantile regression with the incomes of rural farmers divided into four quantiles, we find that engagement in non-farm economic activities reduces poverty incidence for households at all income levels. However, this effect is more pronounced among those in the lower income quantiles. Specifically, non-farm income reduces poverty by 25 percentage points for rural households in the 0–25th income quantile. The impact is even greater for households in the 25th–50th income quantile, where poverty reduces by 66.7 percentage points. In contrast, non-farm income does not have a significant effect on poverty reduction above the 50th quantile. This may be explained by the tendency of such households to already adopt risk management initiatives to protect their farm incomes (Anang et al., 2024). Education significantly impacts the reduction of poverty incidence among rural farmers across the income distribution, with a more pronounced effect on those in the lower income brackets. Use of non-farm credit and family labour has minimal effect on alleviating poverty across all income quantiles while non-farm households headed by males do not experience a reduction in poverty incidence as much as those headed by females, except for households in the 25th–50th income quantile range.

Table 3: Effect of non-farm income on household poverty

Variable	Mean Effect	Q1 (0-25)	Q2 (25-50)	Q3 (50-75)	Q4 (75-100)
Non-Farm Income	-0.269*** (0.037)	-0.250** (0.122)	-0.667* (0.357)	-0.462 (0.423)	-0.283 (0.176)
NF Family labour	0.031 (0.053)	0.025 (0.142)	-0.095 (0.132)	0.078 (0.088)	0.052 (0.094)
Years engaged in NF	0.0021 (0.005)	0.005 (0.009)	0.006 (0.010)	-0.009 (0.010)	0.0043 (0.010)
Education (Years) of HH Head	-0.182*** (0.021)	-0.228*** (0.042)	-0.190*** (0.040)	-0.160*** (0.042)	-0.132*** (0.048)
Non-Farm Credit	-0.001** (0.000)	-0.001 (0.001)	-0.001 (0.000)	-0.001 (0.000)	-0.001 (0.000)
Male	0.369*** (0.092)	0.285* (0.172)	0.249 (0.182)	0.576*** (0.184)	0.386* (0.222)
Constant	1.502*** (0.299)	1.631** (0.749)	4.424* (2.434)	2.650 (3.123)	1.331 (1.495)
Observations	1,240	307	310	311	312

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; Dependent variable is the poverty incidence computed with the aid of the FGT. Here, the computed poverty incidence was not coded as performed in Table 2. Q1, Q2, Q3 and Q4 refer to household income quantiles corresponding to the 0–25th, 25th–50th, 50th–75th, and 75th–100th percentiles, respectively.

Discussion

Our estimates indicate that rural farm households who are engaged in non-farm activities are about 6.7 percentage points less likely to be poor compared to those not involved in such activities. This suggests that participation in non-farm economic activities has significant benefits for rural households, protecting them from poverty. This finding addresses the second objective of the study — examining how non-farm income affects rural household welfare. It demonstrates that non-farm activities act as a crucial financial cushion for rural households, providing resources to meet household needs to alleviate poverty (Neglo et al., 2021; Fuseini, 2018). These finding further aligns with Ba et al. (2021), who also found that non-farm employment reduces the likelihood of poverty by 5.9 percentage points in Mauritania. However, our study reveals that the poverty-reducing effects of non-farm activities are more pronounced among poorer households, particularly those in the lower 50th percentile of the income distribution. This is consistent with the notion that non-farm activities serve as an effective avenue for income diversification and risk management, protecting rural households from fluctuations in farm income arising from unpredicted climatic conditions (Anang et al., 2024; Senadza et al., 2018).

While non-farm activities generally enhance rural households' welfare, our findings further indicate that non-farm income helps stabilize farm-income fluctuations. However, this impact is among households in the upper half of the income quantile; poorer households do not derive this benefit. This directly addresses the first objective of the paper about the role of non-farm income in protecting on-farm income among rural households along the income distribution line. This is likely due to the minimal value of their non-farm incomes, combined with the unfavourable nature of land tenure systems, which may hinder their ability to invest funds from non-farm economic activities in farming activities. As highlighted in the literature, such wide disparities in land ownership and tenure systems limit the ability of poorer households to leverage non-farm income for on-farm investment, reducing the effectiveness of non-farm activities in smoothing farm income, especially among rural households (Alhola & Gwaindepi, 2024). This observation emphasizes that poverty reduction policies must consider household heterogeneity and structural constraints, rather than adopting a one-size-fits-all approach.

Our findings also highlight the importance of education in protecting rural farm income and mitigating poverty. Education played a significant role in reducing on-farm income fluctuations and poverty incidence, especially among poorer rural households. Notably, a year increase in education for household heads raises farm incomes by 13.2% and 11.2 in the 25th and 50th quantile households, respectively. Furthermore, among lower-income and middle-income quantile households, a year's increase in the education of the household head makes such households 22.8% and 19% less likely to be poor, respectively. These results align with literature suggesting that education equips households with the skills needed to engage in more productive non-farm activities, enhances capacity to adopt modern farming techniques, and improves the ability to access information, markets, and support services, which ultimately enhances their welfare (Imai et al., 2015; Knight et al., 2010; Danso-Abbeam et al., 2020). Additionally, our findings suggest that farmland size directly protects farm income across all income quantiles. However, the legislation surrounding land tenure, particularly the poor's inability to negotiate effectively, presents unfavourable conditions for those in the lower income quantile. This highlights the need for the review of land tenure systems to benefit the poor.

The use of family labour in farming does not protect farm income, nor does household size shield families from poverty. However, the use of skilled family labour in non-farm economic activities reduces poverty incidence among rural households. Similarly, access to credit, though not significantly affecting on-farm income, served as a protective mechanism against poverty, reflecting the literature on the importance of financial resources as a complement to non-farm income in enhancing rural livelihoods (Neglo et al., 2021; Ba et al., 2021).

Crop-sharing arrangements were found to negatively impact the non-farm incomes of lower-income households, reflecting systemic weaknesses in land tenure that

disproportionately disadvantage the poor. This finding is consistent with literature indicating that structural inequalities in land access and farm contracts can undermine the on-farm production for the most vulnerable households (Sani, 2017). Finally, gender differences in household leadership play a role in income conversion and poverty mitigation. Male-headed households are more effective at protecting on-farm income with non-farm income, particularly among lower- and middle-income groups. Conversely, female-headed households show better odds of reducing poverty across most income quantiles, consistent with literature highlighting heterogeneity in household strategies for leveraging non-farm income (Atakli & Agbenyo, 2020).

Overall, the findings confirm that non-farm activities serve as both an income stabilization mechanism for on-farm activities and a pathway for poverty reduction for rural households. However, benefits are uneven across income levels, but these are shaped by education, land access, gender, and other household characteristics.

Limitations of the study

The study focuses primarily on rural farm households and leverages shared household characteristics to reduce heterogeneity and partially account for spatial differences in farming practices and local conditions. However, this restriction may still overlook important regional variations in market access, land tenure arrangements, and climatic conditions that could influence both farm and non-farm incomes in Ghana. Moreover, the cross-sectional nature of the data limits our ability to capture long-term causal effects of non-farm income on farm income and poverty reduction. Future research could therefore employ longitudinal or panel data and incorporate more detailed spatial analysis to examine how regional disparities shape the dynamics between non-farm income, farm income, and poverty in rural Ghana.

Conclusion

This paper sets out to investigate whether households primarily engaged in on-farm economic activities can mitigate fluctuations in their farm income through participation in non-farm economic activities. Additionally, it examines how such participation impacts household welfare, specifically poverty. The findings indicate that engagement in non-farm activities helps protect farm incomes, but this benefit largely accrues to wealthier households. Yet, earning non-farm income in addition to farm income has a positive impact on household poverty across all income quantiles. Thus, even though the non-farm incomes of poorer households do not significantly impact their farm incomes, it nevertheless has a poverty reducing effect. This then provides some evidence that even poorer households could significantly benefit from non-farm income participation if the barriers to entry into these activities are removed. The study therefore recommends tailored non-farm capacity training and education programmes that better protect them against farm income fluctuations and alleviate poverty. This could include vocational

training in agro-processing, small-scale trading, and financial literacy to increase the value of non-farm income for rural households. This recommendation bores out of evidence that many rural households engage in low-return, informal non-farm activities due to limited skills development opportunities (Senadza et al., 2018). Additionally, there is a need for targeted support to assist poorer households in navigating land tenure agreements effectively such as legal aid, community land education, and simpler land registration processes to enable them to fully benefit from farm income opportunities. Such recommendation is contingent on rural customary land tenure systems which often create insecurity for poorer farmers, who face challenges in securing long-term rights to land, thereby limiting their incentives to invest in productivity-enhancing activities (Alhola & Gwaindepi, 2024). Finally, improving access to small-scale credit and microfinance would allow households to invest non-farm income in productive farming and use family labour more effectively, maximizing both farm and non-farm income benefits. This is relevant due to the underdeveloped nature of rural financial markets in Ghana (Senadza et al., 2018)

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