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Article

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The influence of off-farm work on farm income among smallholder farm households in northern Ghana

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Abstract: Income diversification is an essential livelihood strategy among small-scale farmers in low-income countries. Through income diversification, farmers can potentially invest off-farm earnings into their farm business to enhance productivity and income from farming. Conversely, working off-farm can lead to a labour-loss effect which can reduce farm performance. This study therefore assesses the effect of off-farm work (OFW) on farm income using data from 486 smallholder farmers in northern Ghana. An endogenous treatment regression model was used to assess the effect of diversifying income sources on farm income. The results showed that involvement in OFW enhanced farm income per acre by GH¢ 386. Other factors that enhanced farm income included years of formal education and access to extension services and input subsidy. Farmer group membership and household size however reduced farm income. The farm sector can therefore take advantage of the positive linkage with the non-farm sector to improve farm income levels of farmers. In this light, government's rural industrialization policy should seek to provide more job

ABOUT THE AUTHORS

Benjamin Tetteh Anang is a senior lecturer at the University for Development Studies whose research focuses on agricultural productivity and efficiency measurement, impact evaluation of agricultural projects and innovations, technology adoption, climate change economics, among others. He has taught and supervised several undergraduate and postgraduate students in his 18 years of teaching at the University and has over forty published articles in local and international peer-reviewed journals.

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PUBLIC INTEREST STATEMENT

Declining farm income is a major challenge facing most smallholder farmers in developing countries. Farm households seek to enhance their level of income through participation in off-farm activities. This has the tendency to lower farm income and productivity if it leads to a loss-labour effect, or enhance farm income and productivity if it improves the liquidity position of the farm household. Using cross-sectional data from smallholder soybean farmers, we assessed the impact of off-farm work on farm income and found that participation in off-farm work enhanced farm income per acre by GH¢ 386. The farm sector can therefore take advantage of the positive linkage with the non-farm sector to improve farm income levels of farmers. Government's rural industrialization policy should therefore seek to provide more job opportunities outside the farm sector to enable smallholder farmers to take advantage of such opportunities to improve income from on-farm activities.

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Subjects: Development Studies; Sustainable Development; Development Policy; Rural Development; Finance

Keywords: off-farm work; farm income; endogenous treatment regression model; northern Ghana

1. Introduction

The critical importance of agriculture in the economic development of African nations like Ghana is widely acknowledged in the literature especially concerning its impact on gross domestic product, employment generation and income generation (Anang et al., 2017; Enu, 2014). The livelihood support systems provided by off-farm work (OFW) are crucial in supplementing agricultural income of farm households. The diversification of income portfolio by farmers has intensified globally especially in less developed countries (Iraoya & Isinika, 2022; Pfeiffer et al., 2009). According to studies, the significance of OFW to farming households' income in Sub-Saharan Africa (SSA) is rising since it accounts for a sizeable portion of overall household income. (Van den Broeck & Kilic, 2019).

OFW comprises of wage employment outside the participant's own farm, and plays a significant role in sustainable rural development and the reduction of poverty from either non-farm-based works or self-employment in non-farm enterprises (FAO, 1998). Thus, off-farm income may be defined as income obtained from wage employment outside one's own farm. This contrasts with non-farm income which refers to wage employment from non-farm activities. According to H. Ahmed and Anang (2019), farm income denotes income obtained from operating a farm which may be both monetary and non-monetary in value. Farm income is crucial for both social and economic reasons (Skarżyńska & Grochowska, 2021). OFW is livelihood diversification strategy which seeks to increase farmers income portfolio (Atuoye et al., 2019). As shown by Pfeiffer et al. (2009) and Issahaku and Abdul-Rahaman (2019), farm household total time is allocated between three major activities of farm production, off-farm work and leisure in order to maximize farm household utility. The involvement of farmers in OFW as an income diversification strategy hinges on the off-farm enterprise's requisite skills and financial requirements (Anang & Yeboah, 2019; Beyene, 2008).

It is important to note that income diversification strategies such as OFW continue to receive a lot of advocacies from both researchers and practitioners of development mainly due to its role in poverty alleviation through improved income (Al-Amin & Hossain, 2019; Anang et al., 2020(a); Iraoya & Isinika, 2022). According to Babatunde and Qaim (2009), majority of farmers engage in off-farm income generating activities. The role of off-farm income in rural poverty alleviation has been widely noted in the literature (Eshetu & Mekonnen, 2016; Li et al., 2021). According to Duong et al. (2021) and Kuwornu et al. (2018) off-farm income enhances farmers total income, daily calorie consumption and food security status. OFW reduces the poverty incidence among farmers (Eshetu & Mekonnen, 2016). Hence, poverty reduction strategies should target off-farm work opportunities in rural areas as off-farm activities have the tendency to lessen vulnerability to poverty in Ghana (Issahaku & Abdul-Rahaman, 2019).

Furthermore, OFW is noted to play a vital role in agricultural technology adoption (Diiro, 2013; Iraoya & Isinika, 2022; Sarker et al., 2021). In Ghana, Issahaku and Abdul-Rahaman (2019) found off-farm employment to be essential in uptake of sustainable land management practices. According to Anang et al. (2020a), M. H. Ahmed and Melesse (2018) and Tenaye (2020), off-farm income enhances total income, productivity and technical efficiency of producers.

Despite the foregoing positive effects of OFW, other studies observed a negative influence of off-farm income on farm output and productivity (Lien et al., 2010; Pfeiffer et al., 2009). Also, OFW is

noted to cause a labour loss effect which could have a negative effect on agriculture (Pfeiffer et al., 2009). However, Anang et al. (2020a) have shown that income from off-farm employment can complement on-farm income to enhance total farm household earnings.

The debate surrounding the effect of OFW goes beyond the lost-labour (or negative labour) and liquidity-relaxing effects. As stated by other authors such as Ahmadzai (2020), other unobserved factors may push farmers to diversify into both farming and non-farming activities. This is because farmers are mostly risk averse and may therefore want to mitigate farm risk by spreading risk over a wider portfolio of activities including both farming and non-farming activities. According to Mishra et al. (2004) diversification of enterprises represents a self-insuring mechanism adopted by farmers to mitigate risk. The decision by farmers to diversify income sources by working for non-agricultural income may be viewed as a risk management strategy aimed at stabilizing livelihood (McNamara & Weiss, 2005).

Studies by Adem et al. (2020) and Nazir et al. (2018) pointed out that the propensity of producers to engage in off-farm income activities depends on household size. Thus, the number of people living in the same household with dependency on same income source for survival has the tendency to compel household members to diversify their sources of income. According to Adeoye et al. (2019) access to utility services serves as an incentive to enhance farmers involvement in off-farm wage employment. Thus, the availability of electricity and portable water usually facilitate creation of off-farm work opportunities. A study by Xing and Gounder (2021), Anang and Yeboah (2019) and Shehu and Abubakar (2015) revealed that farmers with formal education have a higher probability to engage in OFW. In assessing off-farm employment as an income diversification strategy in Ghana, Senadza (2012) and Akrasi et al. (2020) found out that more females participated in OFW as compare to their male counterparts. The implication of this result is that gender plays a critical role in off-farm employment.

There are not many empirical studies showing the effect of working off-farm on farm income of small-scale producers in the Ghanaian context as well as in other developing countries. Studies on off-farm work in Ghana have focused mainly on its linkage with food security, credit fungibility, technology adoption, among a few others, with very little attention paid to its effect on farm income. For example, Ankrah-Twumasi et al. (2022) assessed the linkage between OFW and agricultural credit fungibility in Ghana, while Akrasi et al. (2020) and Kuwornu et al. (2018) investigated the connection between OFW and food security in Ghana. Atuoye et al. (2019), on the other hand, assessed the linkage between income diversification and food insecurity, while Danso-Abbeam et al. (2020) examined the implications of diversifying income sources on household welfare and technology adoption. In all these studies, farm income was not the focus, even though it has an important relation with income diversification. The few studies in Ghana focusing on OFW and farm income include Anang and Yeboah (2019) and Anang et al. (2020a). Anang and Yeboah (2019) used a double-hurdle model in their estimation but did not measure the direct impact of OFW on farm income. Anang et al. (2020a) on the other hand, used propensity score matching which does not account for selection bias to estimate the influence of OFW on farm income. This current study therefore addresses the aforementioned shortcomings in the previous studies and seeks to make an improvement to these earlier studies. Specifically, this study employs an approach that controls for selection bias and measures the direct effect of engaging in OFW on farm income.

As shown by Ahmadzai (2020), other unobserved factors may push farmers to diversify into both farming and non-farming activities. These unobserved factors lead to an endogeneity issue. Also, the choice to take part in OFW is non-random and leads to sample selection bias. This study applies an endogenous treatment effect model to deal with the issues arising from unobserved factors affecting off-farm activity participation to provide consistent parameter estimates of the influence of OFW. The study's objectives are therefore to empirically estimate (1) the factors affecting the choice to engage in off-farm work, and (2) the impact of working off-farm on farm

income of farm households in northern Ghana. The study is significant because it will contribute towards filling a key research gap by analysing the effect of OFW on household farm income using data from Northern Ghana.

2. Materials and methods

2.1 Conceptual framework

Figure 1 presents the conceptual framework underpinning the study. It encompasses the factors affecting engagement in OFW, the productivity effect of participating in OFW and how this relates to the level of farm income.

Participation in OFW is conceptualized to be determined by three key factors, namely farmer/household factors, farm-specific factors and institutional factors. Farmer and household characteristics such as sex (gender), years of formal education, household size, years of farming experience, and marital status are expected to influence the choice to take part in OFW (Akrasi et al., 2020; Nazir et al., 2018; Xing & Gounder, 2021). All things being equal, involvement in OFW is expected to increase with the level of education since education enhances the employability of individuals as it equips them with critical skills needed by the job market. Younger farmers may find it easy to change or find additional jobs, but older farmers with larger households may be compelled by economic factors to seed off-farm job.

Farm-specific factors are expected to affect the choice to take up off-farm employment (Ahmadzai, 2020; Anang et al., 2020a). Farmers with very small farm holdings may seek additional income sources outside the farm to supplement the household income. Farmers with infertile soils may also be tempted to seek additional sources of income outside farming. However, smallholders endowed with farm assets may focus more on their farming activities hence less likely to participate in OFW.

Institutional factors, for example access to credit and farm subsidy are expected to reduce the likelihood to seek OFW (Anang & Yeboah, 2019). Credit reduces the liquidity constraints of farmers and is expected to reduce the likelihood of working outside the farm. Subsidy is expected to have a similar effect because it reduces the cost of production and improves productivity.

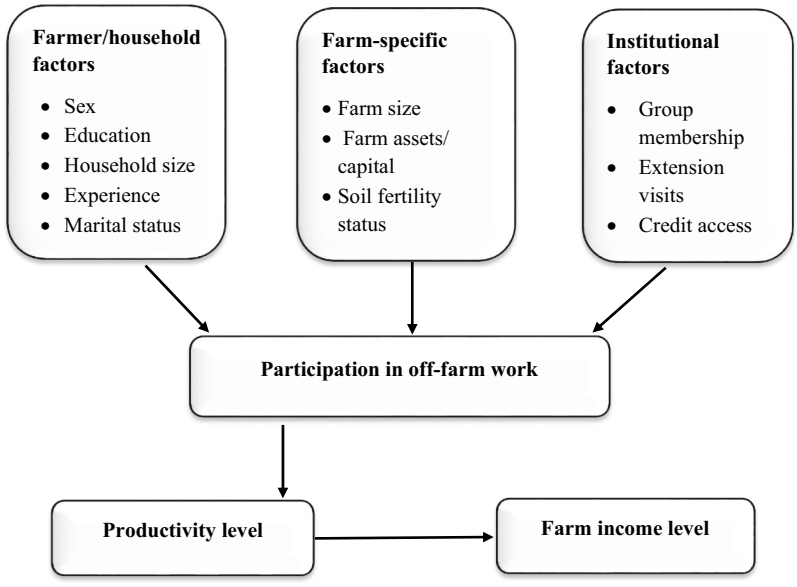

Figure 1. Conceptual framework.

Source: Authors' construction

Farmer/household, farm-specific and institutional factors therefore influence the choice to take part in OFW, which in turn is expected to affect the productivity of farmers. Productivity in simple terms is the output per unit input. At the aggregate level, it is total output per the quantity of inputs used in production. Participation in OFW may lead to a loss-labour effect which may decrease productivity, leading to lower farm income. This means that as farmers devote more time to OFW, they are less likely to devote sufficient time to the farm activities, which may reduce productivity. Conversely, participation in OFW may reduce the liquidity constraints facing the farm business, and may thus lead to higher productivity and improvement of farm income.

There are other unobserved factors that may influence the decision to work outside the farm and therefore may have an influence on farm productivity and net farm income. These unobserved factors include farmers' innate ability, personal motivation, risk-aversion, among others.

2.2 Study area, data collection and sampling method

Northern Ghana served as the study area for the study which currently covers five administrative regions. The study area was selected for this study because of its high agricultural potential, high population of smallholder farmers and high rate of poverty compared to other parts of the country. The primary economic activity in the study area is agriculture which is mostly dominated by smallholder farm households. The vegetation in northern Ghana is primarily savanna with a unimodal rainfall regime spanning June to October and relatively high temperatures averaging 40°C during the dry season. Crops such as maize, yam, soybean, rice, and groundnut are grown with several households involved in livestock farming and either mixed farming or mixed cropping.

Multistage sampling technique was used to select 486 maize producers for the study which covered the 2019/2020 farming season. Five districts across northern Ghana, namely Tolon district, Yendi municipal, East Gonja district, West Mamprusi district, and Bawku municipal, were chosen for the study. These districts are among the major maize producing districts in northern Ghana. Four communities were randomly chosen from each district followed by random selection of 25 farmers from each community to give a total of 100 farmers per district, and a total sample of 500 maize producers. As a result of incomplete information, the data used for the final analysis comprised 486 respondents. Farmers were interviewed with the help of a questionnaire containing both open and close-ended questions. The primary respondent was the household head. Informed consent was sought from each respondent prior to the interviews and farmers who indicated willingness to participate in the interviews were included in the study. The interviews were done by trained enumerators. The questionnaire was pretested and covered all aspects of maize cultivation during the cropping season.

2.3 Estimation strategy

The key variables in the analysis are participation in off-farm work (a binary decision) and net farm income (a continuous variable). The decision to engage in OFW is influenced by both observable and unobservable factors. The observable factors include farmer characteristics such as age, level of education, and gender. Farm-level factors such as farm size and soil-fertility level, as well as institutional factors like access to agricultural extension, credit, subsidy and farmer group membership are other observable factors that determine participation in OFW. Besides these factors, other unobserved factors may influence the decision to engage in OFW. These unobservable factors may include farmer's innate ability and personal motivation. As with employment in every other economic sector, there are no guarantees of obtaining an off-farm employment even if the farmer is ready to work. Thus, participation in OFW is non-random, and introduces an element of selectivity bias.

Econometric estimation of the effect of OFW requires that we control for selectivity bias, otherwise this will result in a biased estimate of the impact of OFW. Another closely related issue with estimating the impact of participation in OFW on farm income is the issue of

endogeneity. The problem of endogeneity typically arises when an explanatory variable in a regression model is correlated with the error term in the model. In the estimation of farm income, the OFW variable is considered to be potentially endogenous. This may arise as a result of measurement error, omitted variables, or simultaneity. One of the commonest approaches for addressing endogeneity issues in the literature is the use of instrumental variables (IV) techniques.

In the extant literature, researchers have used a number of estimation methods to control for both observed and unobserved confounding factors, thus accounting for selectivity bias. These approaches include the Heckman selection model, endogenous switching regression model, regression with endogenous treatment effect, among others. These approaches use a two-step procedure that relies on a selection equation that is typically binary in the dependent variable, and an outcome equation that typically involves a continuous equation. With the Heckman type of models, an inverse Mill's ratio is added as an extra explanatory variable which controls for selectivity bias.

This study adopted the linear regression with endogenous treatment effects model to estimate the impact of off-farm income on farm income following Ahmed and Anang (2019) and Nyaaba et al. (2019). The model was chosen because it controls for both observed and unobserved biases thus dealing with selectivity bias. The linear regression with endogenous treatment effects model is appropriate when the treatment variable is potentially endogenous. Again, the endogenous treatment regression model can be used to compute key impact parameters including the average treatment effect (ATE) or the average treatment effect on the treated (ATET or ATT), while controlling for hidden bias.

2.4 Empirical specification of the endogenous treatment regression model

Assume that Z_i is the treatment variable (participation in OFW) and Y_i is the outcome variable (farm income). Then, the regression with endogenous treatment effect model equation used for the study may be stated as follows:

$$Y_i = X_i\beta + \delta Z_i + v_i \tag{1}$$

$$Z_i = W_i\gamma + u_i \tag{2}$$

where

$$Z_i = \begin{cases} 1, if\ W_i\gamma + u_i > 0 \\ 0, if\ W_i\gamma + u_i \leq 0 \end{cases} \tag{3}$$

Z_i is off-farm income participation variable which assumes the value 1 if the farmer participated in OFW and 0 if otherwise. The vector of outcome covariates is represented by X_i whilst W_i represents the vector of endogenous treatment covariates. The unknown parameters to be estimated are β and γ. The error terms are depicted as v_i and u_i with the covariance matrix depicted as follows:

$$\begin{bmatrix} \delta^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix} \tag{4}$$

The empirical models for the outcome equation and the off-farm income participation models are depicted in Equation 6 and Equation 6 respectively with the variables described in Table 1.

The empirical outcome (farm income) equation is specified below:

Table 1. Characteristics of the respondents

Variable	Description	Mean	S.D.
Net farm income (*Y*)	Net farm income per acre in Ghana cedi (GH¢)	360.6	243.6
Off-farm work	Equals 1 for off-farm work; 0 otherwise	0.276	0.447
Age (*age*)	Age in years	41.13	13.79
Sex (*sex*)	Equals 1 if male; 0 otherwise	0.759	0.428
Married (*mar*)	Equals 1 if married; 0 otherwise	0.879	0.327
Education (*edu*)	Years of formal education	3.724	5.378
Household size (*hh*)	Number of household members	9.932	5.926
Extension visits (*ext*)	Equals 1 for access to extension; 0 otherwise	0.459	0.499
Subsidy (*sub*)	Equals 1 for access to subsidy; 0 otherwise	0.679	0.467
Group member (*gmemb*)	Equals 1 if farmer group member; 0 otherwise	0.307	0.462
Farm size (*fsize*)	Farm size in acres	3.678	2.098

Note: GH¢ 1.0 = US $ 0.167 in 2020

$$Y_i = \beta_0 + \beta_1 age_i + \beta_2 sex_i + \beta_3 mar_i + \beta_4 edu_i + \beta_5 hh_i + \beta_6 ext_i + \beta_7 sub_i + \beta_8 gmemb_i + \beta_9 fsize_i + \beta_{10} Z_i + v_i \quad (5)$$

The empirical off-farm income participation empirical model is specified as follow

$$Z_i = \gamma_0 + \gamma_1 age_i + \gamma_2 sex_i + \gamma_3 mar_i + \gamma_4 edu_i + \gamma_5 hh_i + \gamma_6 ext_i + \gamma_7 sub_i + \gamma_8 gmemb_i + \gamma_9 fsize_i + u_i \quad (6)$$

The variables included in the study are described in Table 1.

OFW is expected to have an indeterminate influence on farm income depending on whether involvement in OFW results in a lost-labour effect or the income from OFW is re-invested into farming. Age is also assumed to have an indeterminate influence on farm income because older farmers are less energetic to farm but could hold greater assets for farming, while younger farmers may be energetic and enthusiastic about farming but may lack the resources to do so. With regards to off-farm income, younger farmers are anticipated to be more likely to earn off-farm jobs and income. Years of formal education is expected to enhance off-farm engagement as well as farm income in line with Anang and Yeboah (2019). Access to extension and subsidy are both expected to promote farm income, just as membership of groups and number of household members (Adem et al., 2020; Nazir et al., 2018). The study further hypothesizes a higher farm income and income from OFW for married couples while male farmers are expected to earn higher farm incomes than female farmers but participate less in OFW due to the high entrepreneurial abilities of rural women in Ghana. Women are also usually more constrained in terms of land ownership for farming hence more likely to participate in off-farm jobs. Anang and Yeboah (2019) observed that female farmers in northern Ghana had higher inclination to engage in OFW.

3. Results and discussion

3.1 Characteristics of the respondents

The analysis of the data from the survey shows that the average farm income per acre of OFW participants exceeded that of non-participants with a mean difference of GH¢58.75 as depicted in Table 2. This means that involvement in off-farm employment can boost income from farming and subsequently the total farm household earning. The result aligns with the general assertion that several farm households participate in OFW to supplement and diversify their income sources. Income from other sources are also potentially transferred to support the farm business, thus resulting in higher farm returns.

Farmers engaged in OFW had more participation in farmer-based organisations compared to non-participants. The result indicates that farmers who diversify their income sources are also likely to depend on social networks to enhance their economic fortunes. Also, OFW participants benefited more from extension services compare to non-participants. Thus, involvement in farmer-based organisations and accessibility to extension services are likely to enhance the probability of farmers to participate in off-farm jobs. Participants in off-farm jobs had more years of formal education on average as compared to non-participants. The reason for this may be that education increases individuals' chances of engaging in off-farm employment since skills for off-farm enterprises can be acquired by obtaining formal education.

3.2 Farm income per acre of the respondents

The households' minimum farm income per acre was found to be GH¢30 whilst the maximum recorded farm income per acre was GH¢1400 as shown in Table 3. A significant fraction of the farm households (191 out of 486 households which is equivalent to about 39% of the total sample) earn farm income per acre within the ranges of GH¢201 – GH¢400 and a mean farm earning per acre of GH¢361.2 as presented in Table 3. The figures indicate low earnings from farming among the

Table 2. Characteristics of the respondents according to off-farm participation status

Variable	Participants (*n*=134)	Non-participants (*n*=352)	Mean diff.
	Mean (SD)	Mean (SD)	
Farm income (*Y*)	403.2 (259.5)	344.4 (235.6)	58.752**
Age (*age*)	41.47 (14.01)	41.00 (13.72)	0.470
Sex (*sex*)	0.724 (0.449)	0.773 (0.420)	−0.049
Married (*mar*)	0.873 (0.334)	0.881 (0.325)	−0.008
Education (*edu*)	4.485 (5.902)	3.435 (5.144)	1.050*
Household size (*hh*)	10.59 (5.848)	9.682 (5.945)	0.908
Extension visits (*ext*)	0.560 (0.498)	0.420 (0.494)	0.139***
Subsidy (*sub*)	0.642 (0.481)	0.693 (0.462)	−0.051
Group member (*gmemb*)	0.410 (0.494)	0.267 (0.443)	0.143***
Farm size (*fsize*)	3.806 (2.100)	3.629 (2.098)	0.177

Note: GH¢ 1.0 = US $ 0.167 in 2020

Table 3. Farm income per acre

Farm income in Ghana cedis (GH¢)	Frequency	Percent
1–200	131	26.95
201–400	191	39.30
401–600	101	20.78
601–800	29	5.97
801–1000	20	4.12
1001–1200	12	2.47
1201–1400	2	0.41
Total	486	100

Mean = GH¢361.2, minimum = GH¢30, maximum = GH¢1400.
Note: GH¢ 1.0 = US $ 0.167 in 2020.

respondents which is in line with expectation. Smallholder farmers in Ghana earn very low incomes from farming due to low output prices and the pressure to sell immediately after harvest to cater for immediate family needs. Poor returns from farming is a huge disincentive to agricultural production in the country and hampers technology adoption, agricultural intensification, and farm productivity and profitability.

3.3 Results of the endogenous treatment regression model

3.3.1 Determinants of income diversification

We present the findings from the first stage regression as specified by . The endogenous treatment regression model used to estimate the determinants of income diversification decision has a good fit as indicated by the significance of the chi-squared estimate of the Wald test of the independent equations as depicted in Table 4 (column 2). The results show that initially, low level of education does not affect off-farm employment, but higher level of education plays a positive role in determination of farmers' involvement in off-farm employment at 5% significant level. What the result indicates is that low level of formal education has limited influence on off-farm employment, but the effect is positive and significant at higher level of education. This result synchronizes with that of Anang et al. (2020) and Danso-Abbeam et al. (2020) who noted that formal education is critical in off-farm employment skills acquisition. Formal education is a major factor that enhances the employability of labour. However, Beyene (2008) in a study in Ethiopia observed that educational status had no influence on farmers choice to partake in OFW.

The findings further indicate that the decision to work off-farm is positively associated with farm size. What the finding indicates is that producers with larger farm holdings have a higher propensity to engage in off-farm employment. Such farmers may be taking advantage of the complementarities that may exist between employment in the off-farm and farm sectors as a risk management strategy to stabilize household income. The finding is similar to that of Pramanik et al. (2014) who found Bangladeshi farmers with larger plots more likely to engage in OFW. Anang et al. (2020) and McCarthy and Sun (2009) reported similar results in their studies in Ghana.

Producers' access to input subsidy reduced the incentive to participate in off-farm jobs, which aligns with a priori expectation of the study. Farm input subsidy may be regarded as a form of disguised payment to farmers and this form of support is likely to reduce the need to work outside the farm to generate extra income to support the farm business. The result of this study implies that access to subsidy motivates farm households to devote their working time exclusively to their farming activities. However, this result diverges from that of Hennessy and Rehman (2008) which showed that farm subsidy enhances off-farm employment participation among Irish farmers.

Table 4. Determinants of income diversification and farm income

Variable	Determinants of off-farm work		Determinants of farm income	
	Coefficient	Std. Err.	Coefficient	Std. Err.
Age	0.005	0.005	−0.079	1.051
Sex	−0.150	0.140	14.46	29.55
Married	−0.090	0.201	46.99	41.95
Education	−0.036	0.038	18.88**	7.961
Education squared	0.005**	0.003	−1.267**	0.551
Household size	0.012	0.011	−6.563***	2.258
Farm size in acres	0.031*	0.018		
Extension visits	0.187	0.126	82.31***	27.11
Access to subsidy	−0.246*	0.136	101.5***	29.12
Farmer group member	0.395***	0.128	−62.84**	28.21
Off-farm work* Education			10.78***	3.806
Off-farm work (Z)			386.3***	37.72
Constant	−0.963***	0.298	153.4**	61.94
Diagnostic statistics				
/athrho	−1.264***	0.144		
/lnsigma	5.607***	0.050		
rho	−0.852***	0.039		
sigma	272.4***	13.55		
lambda	−232.2***	20.87		
Wald test of indep. eqns. (rho = 0): Chi squared (1)	77.23***			

Note: ***, ** and * means significant at 1%, 5% and 10% respectively.

The study also revealed that farmer-based organization membership status correlates positively with off-farm participation. The result is consistent with general expectation because farmers tend to learn from each other through information sharing. Thus, in participating in farmer groups, farmers share market information among themselves which makes members aware of opportunities outside the farm sector that could inure to their benefit, especially when one considers the dwindling returns from farming. This result agrees with that Ankrah-Twumasi et al. (2021) which concluded that farmer group membership enhances net farm income through off-farm income improvement.

3.3.2 Determinants of farm income

The results of the determinants of farm income among the smallholder farmers is presented in the third column of Table 4. These results are related to the second stage (main outcome estimation) as specified by Equation (1). The results show a negative association between farm income and household size at 1% significant level. A large farm household size has the potential to affect the farm household's total disposable income hence, causing a reduction in financial resources available for farm production activities. The result, however, contradicts that of Anang et al. (2020b) and Ibekwe et al. (2010) which found household size to improve farm income through labour supply.

The effect of education on farm income indicates that farm income increases at a decreasing rate with number of years of education. The finding indicates that education increases producers' income but beyond a certain threshold, farm income begins to decline. Thus, while education

improves farm income, the relationship is characterised by diminishing returns, which aligns with our expectation.

The interaction term of years of education and OFW also provides an interesting result. The variable is positive and significant at 1% significant level indicating that educated farmers who engaged in off-farm jobs earned higher farm income compared to educated farmers who did not take up off-farm employment. Thus, the opportunity cost of an educated farmer's labour may be higher, promoting participation in off-farm employment. Educated farmers may also earn relatively higher wages which may be re-invested into farming to improve farm income.

The provision of extension service to the farmers was found to positively affect farm income at 1% significant level. This finding is consistent with that of Anang et al. (2020a), Baiyegunhi et al. (2019), Allotey et al. (2019) and Danso-Abbeam et al. (2018) which revealed that extension service enhances total household farm income. This may be due to the utilization of production and technical information provided by extension service workers to improve production thereby enhancing total farm revenue.

Farmers' access to agricultural input subsidy was found to enhance farm income which agrees with our *a priori* expectation. Access to input subsidy, particularly fertilizer subsidy enables farmers to intensify their use of such input in production to enhance productivity. Smallholder farmers are generally poor and use limited amounts of essential farm inputs like chemical fertilizer. Input subsidies therefore enable farmers to use optimal levels of these inputs to boost production. Input subsidies can help to stabilize the variability in farmers' income. However, for subsidies to be effective, Bojnec and Fertő (2019) concluded that they should be targeted at farmers who need them most in order to achieve the intended benefit of farm income stabilization.

Furthermore, farmer group membership was found to affect farm households' income negatively, contrary to the study's *a priori* expectation. Farmer groups are expected to be avenues for information sharing and farmer-to-farmer learning, thus promoting general welfare and farm output. This outcome is dependent on the internal dynamics of the groups, individual participation in group meetings and activities, free-riding behavior, among others. The finding contradicts that of Aku et al. (2018) and Bachke (2019) which revealed that farmer group membership significantly enhanced farm income as a result of providing members with market information and improving accessibility to markets.

The effect of OFW on farm income which is the main variable of interest in this study is presented in Table 4 (the third column). The result reveals that engaging in OFW increased farm income per acre of the respondents by GH¢ 386.3. The result agrees with Anang et al. (2020a) in their study in Tolon district of Ghana as well as that of Neglo et al. (2021) on off-farm activities in Ethiopia which confirmed that OFW positively influences farm income. Farm households typically participate in off-farm activities as an income diversification strategy especially in the face of declining farm incomes exacerbated by climate change and unstable economic factors that make farmers worse-off. Off-farm activity participation is one way by which farm households can finance on-farm investment activities. Investment in agriculture from off-farm income is a critical feature of smallholder agriculture in developing countries where OFW serves as a major coping strategy to safeguard against the loss of livelihood.

4. Conclusion and policy recommendations

The study investigated the effect of off-farm work on farm income relying on data from 486 smallholder maize producers across northern Ghana. An endogenous treatment effect model was used to analyze the effect of OFW on farm income. The results revealed that participation in OFW enhanced farm income per acre by GH¢ 386.3. Educated farmers who engaged in OFW earned higher farm income compared to educated farmers who did not take up off-farm employment. Other factors that enhanced farm income include years of formal education and access to

extension services and input subsidy. However, membership of farmer groups and household size were found to reduced farm income.

Based on the findings, the authors recommend that farmers should be encouraged to diversify their operations into non-farm activities. This will help reduce production risks, if for instance farming activities fail as a result of crop failures due to extreme weather shocks or pest infestations. In this way, farmers could benefit to survive from OFW. However, this will depend on whether OFW improves the total income of the household, or whether households are likely to earn more farm income if they focus more on farming or allocate more labour time to farming.

The important policy implication for the agricultural sector is for farmers to take advantage of the positive linkage with the non-farm sector enterprises to improve farm households' income levels. It is recommended that government's rural industrialization policy should seek to provide more job opportunities outside the farm sector to enable smallholder farmers to take advantage of such opportunities to support and improve income from on-farm employment opportunities.

Finally, we identify the following as a limitation of the study. The study did not control for location factors which we assumed could influence participation in OFW. Future studies should therefore take this into account, particularly, village-level effects that may have an influence on participation and the outcome of interest.

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