Impact evaluation of households participation in agriculture on welfare in Ghana

Solomon Yaw Agyeman-Boaten[1], Abel Fumey[2*] Sheriff Bediako Norman[2]

[1]Faculty of Economics and Social Sciences, Christian-Albrechts-Universität zu Kiel, Germany. yagyemanboaten@gmail.com

[2&3]Department of Economics, University of Ghana. [1]afumey@ug.edu.gh

[3]normanbediako@yahoo.com

*Corresponding author

Abstract: The role of agriculture in Ghana's economic development cannot be overstated as it is a major contributor to GDP and employs more people in the rural areas thereby improving on their welfare. However, the sector's performance in recent time has declined as poverty incidence has remained high among rural agriculture households. This study, therefore, examines how participation in agriculture activities impact households' welfare in Ghana using the seventh edition of Ghana Living Standard Survey (GLSS) dataset conducted in 2016/2017. The Heckman probit model is applied to determine the drivers of households' probability of engaging in agriculture. The propensity scores matching technique is used to match the farming households to their replica non-farming households as counterfactuals to ascertain the welfare impact of the households. The result shows that the welfare of households in agriculture is multidimensionally deprived than non-agriculture households. In addition, factors such as size of household, sex and age of household head, age at first marriage, location, ethnicity, and educational level of household heads have the likelihood of influencing agriculture participation in Ghana. Therefore, by modernising agriculture to enhance value addition through technology, irrigation, financing and marketing to boost agribusinesses would enhance the welfare in the agriculture households.

Keywords – Agriculture, Heckman probit, Household participation, Ghana, Multidimensional welfare, Propensity Score Matching

1. INTRODUCTION

The main role of Governments in every economy is to ensure a better living standard for its citizens at all levels as such socio-economic programmes are always drawn and implemented to achieve this objective. In Ghana, some policy interventions over the last two decades to alleviate poverty and inequality among the populace include capitation grant, free distribution of school uniforms, school feeding programme, livelihood empowerment against poverty (LEAP) among others (GSS, 2018). In 2017 specifically, Government began a free senior high school programme aimed at making secondary education accessible to every child free of charge. All these efforts by the

government are targeted at granting the poor and the vulnerable opportunity to attain an acceptable standard of living, access to affordable healthcare in order to improve their human capital (Chanimbe & Opoku, 2021).

Agriculture is considered the mainstay of most developing countries as it provides employment for over fifty percent of the population and ensures food production and nutritional needs as well as incomes to the economies (World Bank, 2018). Export of agriculture products to earn foreign exchange in order to support their budgets and international reserves. Agriculture activities in developing countries, particularly Ghana not entirely a rural economic venture as over the years, it has gained increasing prominence in urban centres due partly to increasing rural-urban migration in the country (Abass et al., 2013). The rapid urbanisation tends to be gradually depleting the rural agricultural areas of energetic and productive youth thereby hindering agricultural productivity and threatening food security in most developing economies (Martey et al., 2020). In the end, this has the potential to adversely affect the living standards of people engaged in agricultural activities, particularly agriculture households. In this respect, policymakers need to consider the welfare of people involved in agriculture in order to fashion out interventions to improve their wellbeing.

The poverty profile report according to the GLSS 7 indicates that farming households in Ghana top the poverty incidence (GSS, 2018). However, agriculture remains a very significant income source and livelihood for most rural area households despite recent shifts to non-farm activities (Davis et al., 2017). The potential rise in rural incomes from agriculture and related activities makes it a direct target for poverty reduction (FAO, 2001). Though evidence points to a reduction in poverty among self-employed farming households from 45.1 percent to 39.2 percent and a rise to 42.7 percent between 2005/06, 2012/13 and 2016/17, respectively, poverty continue to remain high among households engaged in self-employed agriculture relative to other employment status of households (GSS, 2018). The declining importance of the agriculture sector to the country's GDP in recent times could explain the high incidence of poverty among agriculture households (World Bank, 2017).

The foregoing discussions provide enough grounds for investigating the welfare of households engaged in agricultural activities in Ghana in respect of welfare disparity between farm and non-farm households. That is, a comparative examination of households' welfare regarding agriculture participation and non-participation. Further analysis of welfare differential between rural and urban farm households is of essence for policy since the GSS (2018) poverty profile further points out that households headed by females have improved welfare than those led by males in respect of poverty incidence. Hence a need for examining the welfare impact of farm households from gender perspectives with a focus on the household heads.

This study, therefore, attempts to determine the factors that drive households' participation in agriculture and their welfare impact in Ghana where there is a dearth of studies on the subject. Findings of this study would help shape policies aimed at reducing poverty in fulfilment of Sustainable Development Goals (SDGs) one to five. Following section one above which focuses on the introduction of the study is section two which presents a brief literature review and then section three where the emphasis is on methodology used for the analyses while the findings are reported and discussed in section four. The last part, section five deals with the conclusions and policy directions.

2. LITERATURE SURVEY

Most studies have indicate that agriculture sector growth leads to significant multiplier effects on other economic sectors such as industry and services in the economy (Datt & Ravallion, 1996; De Franco & Godoy, 1993; Coxhead & Warr, 1991). Empirical evidence show that a 1 percent increase in GDP relative to an increase in agriculture expenditure suggest that poorer households benefit more than less poor households in agriculture. Additionally, World Bank (2007) growth driven by agriculture generates more significant welfare impact than the one driven by non-agriculture activities, particularly among the 20 percent poorest of the population. According to Irz et al. (2001), generating greater income for farmers is the most direct contribution of agriculture sector's growth in an

economy. General equilibrium models have been developed with increasing degrees of sophistication by linking agriculture to overall economic growth. Though there are empirical evidences in support of the model, there is no particular model which is generally accepted to produce a unique solution for all economies hence the model choice is expected to be country dependent (Thirtle et al., 2001). Likewise, a cross-country study by Gallup et al. (1998) found that one (1) percent rise in agricultural GDP contribute to 1.61 percent rise in incomes of poorest household (Thirtle et al., 2001; Irz et al., 2001). It is hypothesized that agriculture growth contributes to poverty reduction especially in developing countries, however, evidence suggests that large dataset in support of this position is quite new hence requires further enquire. Nonetheless, other researchers employed different methodologies by using this relatively new dataset to demonstrate the importance of agriculture growth on poverty reduction across many economies (Ravallion & Datt, 1996; Timmer, 1995; Thorbecke & Jung, 1996; Schneider & Gugerty, 2011).

The strength of agricultural multiplier effects is defined by the structure of an economy even though empirical evidence suggests that presence of non-tradable goods create local economic activities. For instance, smaller economies, such as Lesotho with larger tradable sector tend to experience smaller multiplier from agricultural increase than bigger economies such as Nigeria, Tanzania and Cameroon with significant share of non-tradable goods and services (World Bank, 2007). Timmer (1995) notes that good nutrition and investment in health and education emerged out of policies directed at more food production and farm incomes. It has been suggested that increase in the agriculture sector may reinforce an infrastructural demand and generate more tax revenue to support and finance it, including social capital via increased interactions among farmers and relevant agents in the agricultural supply chain (Irz et al., 2001). Other cross-regional studies reveal that labour productivity in agriculture has significant effect on the poorest (Bravo-Ortega and Lederman (2005). However, the study finds that advances in labour productivity in agriculture tends to benefit the richer quintile than the poorest households.

Through forward and backward linkages, higher agriculture propels rural and urban non-farm sector employment (Hanmer & Naschold, 2000). This decreases urban poverty through low rural-urban migration and low food prices. In this case, both poor farmers and landless labourers benefit from agricultural growth through increased production and employment. Ostuka (2000), and Binswanger and Quizon (1989) find that the green revolution decreased inequality and poverty through output expansion that led to food price decline in the primary mechanism. In India, a study shows that growth in farm yield contributes to poverty alleviation thereby improving welfare. However, related works show that output increase can also increase poverty through income elasticity of demand (Datt & Ravallion, 1998). Thus as food prices decline, it translates into real income increases by households thereby increasing net food purchases to enhance household consumption. Furthermore, demand for agriculture products and services upstream and downstream the value chain tends to increase agricultural production. The determinants of these multiplier effects include tradability of goods and services produced in an economy and the associated demand for them, level of rural infrastructure, population density, technological changes in agriculture and extent of processing agricultural products (Irz et al., 2001). According to Berdegue, Reardon and Escobar (2009), evidence shows that Rural Non-Farm Economies (RNFE) is more dynamic in areas where agriculture thrives. However, contrary to farm participation, the evidence reveals that though the impact is positive on welfare, off-farm participation is negatively influenced by agricultural production (Kinyanjui et al., 2019).

Abey et al. (2021) find that both the young and the old participate in agriculture at a similar rate but participation in non-farm wage employment and business activity varies with age which tends to peak around age thirty. In addition, individuals choose to engage in agriculture for various reasons and there exit positive relationships between economic welfare and small-scale farmer participation (Mossie et al., 2021). Dimelu et al. (2020) find the major determinants of youth agricultural activities to be the household size and social organisations' membership. In a related study, gender of participating students and race/ethnicity affect the recruitment of students doing agriculture at land-grant and non-land-grant universities (Alston et al., 2020). Investigating the

feminisation of agriculture, a study concludes that a process-driven largely by out-migration of men from rural areas, the feminisation of agriculture and the wider indicators of women's social or economic empowerment has no relationship, but the growing participation of women in agriculture strongly relates to several indicators of poverty (Pattnaik et al., 2018). In a similar study in India, the authors find that while economic factors seem to influence women's participation in farming, feminisation of agriculture is distress-led with class in terms of income and caste in terms of social groupings (Pattnaik & Lahiri-Dutt, 2020).

It is clear from the literature above that various approaches have been adopted by researchers to examine the factors that influence agricultural participation and their effect on the farmers' welfare. However, not much is known in terms of studies that seek to examine the welfare of participants in agricultural activities, hence this research attempts to fill the void by using a Heckman probit model to examine the determinants of agriculture engagement in Ghana. Additionally, the impact assessment of participants in agriculture is also determined by the propensity score matching technique where the output measure is expressed in terms of multidimensional poverty index using a national representative survey data on Ghana.

3. RESEARCH METHODOLOGY

3.1. The Heckman Probit Model

The Heckman probit regression model is employed to estimate the influencing probability factors of a household's participation in agriculture. The assumption here is that households decide to engage in agriculture or otherwise for many reasons which may include, welfare improvement, as a hobby and the nature of agricultural activity, among others. Since the selection process is not random but self-selection, using standard probit estimations could lead to overestimating the entire population of households due to selection bias (Cuddeback et al., 2004). That is, because in their decision to engage in agriculture households may be self-selected, the Heckman probit regression with sample selection model is employed for this study to deal with the selection bias.

The Heckman type models rely on estimation of two multiple regression models which are the outcome equation and the selection equation (Barnighausen et al., 2011; Bushwey et al., 2007). The simultaneous equations allow for any correlation between unobserved error terms of the dependent variables and this makes the Heckman model very sensitive hence the model will not converge if the criteria listed below are not satisfied (Morrissey et al., 2016; Barnighausen et al., 2011).

1) A complete set of observation for each participant and non-participant variables.
2) An appropriate dependent variable in the selection model for participation and non-participation in the survey.
3) Selection of appropriate exclusion variables in the selection model.

Given Y_1 and Y_2 denoting the two models, explanatory variables of Y_1 is observed if and only if those of Y_2 are also observed. Thus, for the two equations, Heckman selection model is applied if the explanatory variables of the first equation are observed if and only if those of the second equation are equally observed. Assumptions that underpin the Heckman selection are the normal distribution of the error terms of the two equations: $(\varepsilon_i, \mu_i) \sim N(0,1)$. Also, the error term should be independent from the explanatory variables x_i in both equations. There exist a correlation between the error terms: $(\varepsilon_i, \mu_i) = \varrho$; hence, estimating the model with the Ordinary Least Square (OLS) may lead to inconsistent estimates due to the correlation that may exist in both equations, as such the likelihood ratio test is considered appropriate for the model selection bias (Vella, 1998). The null hypothesis is that there is no correlation between the error term and selection of the outcome models. A rejection of the null hypothesis implies that there exists a selection bias which may be corrected by applying the Heckman probit selection method. The Heckman probit model is flexible quite simple to use and through the sample specification errors, the model provides estimates close to the maximum likelihood estimates which are consistent and asymptotically efficient (Heckman, 1979). Sample selection would occur in this study if the unobservable characteristics that determine households'

participation in agriculture correlate with the unobservable characteristics that determine households' non-participation in agriculture.

3.2. Probit Regression

The study follows from Chaix et al. (2011) in identifying the right selection model to employ and uses neighbourhood data where participants and non-participants live in order to determine selection participation as a cohort study. Since the modelling is based on individuals' decision to participate in an activity or not then the dependent variable for the selection model becomes binary one. The choice to participate in agriculture means one is part of the groups of individuals who are working or are with a job, no matter the status of the job or service rendered. That is, out of the working class, individuals who engage in agriculture can be found. Work status of households is considered a proxy for the dependent variable in the selection model. Hence, the binary variable of whether a household is observed to have a job (working) or not is used as a proxy for the dependent variable in the selection equation. Households are then observed to participate in agriculture if and only if they are engage in any work.

In simple terms, Prob (*AgricHHi*) =1 if and only if Prob *(Jobbing)* =1. Morrissey (2016) noted that the standard errors of the Heckman approach may bloat if there is evidence of collinearity between the included explanatory variables and the correction term. Therefore, a non-collinearity may be achieved between the outcome and the selection models if an exclusion restriction *Zi* affects the reason for individuals' selection to participate in an activity but do not influence the outcome variable in the selection model. Bushway et al. (2007) argue that the following steps should be considered to identify valid exclusion restrictions.

1) Find available variables in the survey that could be associated with the survey participants.
2) The exclusive variable, *Zi*, should not be a relevant variable to predict the dependent variable in the outcome equation.
3) There must be a test to verify the significant association between the selection variables with participants in the selection model while controlling for other observed variables.

Based on the above steps, several potential variables were tested exclusion criteria with a probit model, but ethnicity was found to be the appropriate exclusive criteria, Zi, for the selection equation. A test of ethnicity variable showed a significant and negative association with the work status of the households (Jobbing), the survey participation variable but unrelated to household agriculture engagement (AgricHH), the outcome variable.

Consequently, the two-step Bivariate Probit Model begins with the outcome model (a probit model) as specified below.

$$y_i^* = \beta x_i + \varepsilon_i$$

$$y_i = 1 \text{ if } y_i^* > 0,$$

$$y_i = 0 \text{ otherwise} \dots\dots\dots\dots\dots\dots (1)$$

Where y_i^* is an unobserved latent variable that determines the likelihood of respondent *i* to participate in agriculture. x_i is a vector of observed characteristics. The observed demographic characteristics of the head of the household include age, sex, household size and marital status, the household's location and education level. The observed socioeconomic characteristics of household heads include employment status and household income. ε_i is the random error term and β is the vector of parameters in the model.

Morrissey (2016) notes that even though probit model (uses normality) and logit model (uses log normality) are used interchangeably by researchers, the probit model is more appropriate since all the features of the Heckman estimator are based on the assumption of bivariate normality (Bushway et al., 2007). In view of this, the probit regression is applied to the selection model and estimated using maximum likelihood (Greene, 1995, 2000). This is shown below:

$$s_i^* = \alpha x_i + \phi z_i + \mu_i$$

$$s_i = 1 \text{ if } s_i^* > 0, \ s_i = 0, \text{ otherwise}$$

$$y_i \ observed \ if \ s_i = 1 \ .... \ (2)$$

Where, s_i^* is an unobserved latent variable that determines the likelihood of households' work status i, x_i remains a vector of observed characteristics, z_i a vector of exclusion restrictions and μ_i is the random error term of the selection model.

The expected outcome for households who do not work depends only on the observed characteristics x_i if there is no correlation in the error terms. The characteristics of the unobserved workers are the same as those that work or have a job. Meanwhile, if work status and agriculture engagement are correlated, the information that a household does not work changes the conditional distribution of ε_i for that household and the likelihood that it engages in agriculture. Accordingly, the error term, ε_i becomes biased. The correlation between error terms of substantive and selection models is measured by the parameter rho, ρ (Barnighausen et al., 2011; Clark & Houle, 2014). Rho, ρ potentially ranges between -1 and +1. If the selection model's regression coefficients and the substantive model regression coefficients were estimated by identical processes, a potential selection bias (an absolute value of 1) occurs. On the contrary, the value of ρ which is closer to zero (0) suggests that data is missing randomly. This implies that the regression coefficients of the substantive and the selection models are estimated by unrelated processes and hence, less evidence of selection bias (Barnighausen et al., 2011; Clark & Houle, 2014). Based on this study, a significant negative rho, ϱ indicates households that do not work are more likely to participate in agriculture than those who work. Conversely, a significant positive rho, ϱ indicates that working households are less likely to participate in agriculture.

3.2.1. Propensity Score Matching (PSM)

The impact of households' engagement in agriculture on household welfare is assessed using the propensity score matching (PSM) method. Owusu et al. (2011) posit that using PSM has the advantage of not assuming a particular functional or distributional form in the impact estimation. The PSM controls for selection bias, reduces the dimensionality of any matching problem and controls for observable confounding factors to produce unbiased estimates (Becker & Ichino, 2002; Francesconi & Heerink, 2010). On the other hand, it has been observed that in the presence of unobservable selection biases, PSM may also yield bias estimates while others argue that when unobserved variables influence both treated and outcome variables simultaneously; unobserved heterogeneity (hidden bias) occurs (Rosenbaum & Rubin, 1983; Rosenbaum, 2002; Keele, 2010; Martey, 2018). These come at the cost of assuming no measurement and sampling errors (Sherlund et al., 2002). A parametric Heckman probit regression is used to address the influence of the unobservable factors with data on the 'ideal' set of identified households that engage in agriculture and those that do not.

The propensity score expression (x) defines the probability of household i's participation in agriculture conditional on a vector of household and community characteristics (x_i). This can be expressed as $Pr(x) = Pr(Ii = 1|Xi) = F\{h \ Xi\}$……………………….. (3)

Where $F\{.\}$ represents any standard probability model preferably *logit* (see Rosenbaum & Ruben, 1985). The probability model provides the probability that a household will engage in agriculture, given their characteristics. The non-linear nature of the model requires that it should be estimated with a maximum likelihood estimator. Two assumptions underscore the feasibility of matching agriculture and non-agriculture participants: *conditional independence and common support*. The seminal works of Rosenbaum and Rubin (1983) originated the conditional and independence assumption. It shows that it should be possible to estimate the counterfactual of agriculture participation with the expected outcome of non-agriculture engagement conditional on their propensity scores. The relation is, therefore defined as:

$\{[Y0i], Ii = 1, Xi = x\} = \{[Y0i], Ii = 0, Xi \approx x\}.$ .... (4)

Since the probability of observing two units with the same propensity score values is theoretically, zero (0) and (x) is continuous then it is extremely difficult to exactly execute the matching, as such, closeness in propensity scores is considered in the analysis (Rosenbaum & Rubin, 1985; Martey, 2018 and Becker & Ichino, 2002). The closeness in propensity scores assumption requires agriculture participation and non-agriculture participation to be matched over a region defined by the propensity scores as $0 < (x) < 1$. The treatment effect of agriculture engagement is estimated in this region of common support. Cobb-Clark and Crossley (2003) explained that the common support assumption is required because if $f(x) = 1$ for some x, then the assumption of conditional independence does not hold since there will be no observations on $\{Y0i, Ii = 0, Xi = x\}$ from which to construct counterfactuals for participants with $Xi = x$.

3.3. Empirical models for the impact estimation

The treatment effect models are specified below.

$Welfare = \delta_0 + \delta_1 lnh + \delta_2 SEXHH + \delta_3 lnAgeHH + \delta_4 HHEDU + \delta_5 Loc2 + \delta_6 EthGHH + \delta_7 AgeMarHH + \delta_8 MarStaHH + \upsilon_i$ .... (5)

$AgricHH = \sigma_0 + \sigma_1 lnh + \sigma_2 SEXHH + \sigma_3 lnAgeHH + \sigma_4 HHEDU + \sigma_5 Loc2 + \sigma_6 EthGHH + \sigma_7 AgeMarHH + \sigma_8 MarStaHH + \psi_i$ .... (6)

Both equations (5) and (6) are estimated together in the treatment effect model.

3.3.1. Measurement of the outcome variables: The multidimensional proverty index (MPI)

Fergusson *et al.* (2001) indicate that to achieve the present objective of assessing the contributions of different indicators on variation in people's living standards, the appropriate means of welfare measurement is to employ the standard of living approach relative to the income or expenditure-based measures. Approximating the welfare of the agricultural households in Ghana, the multidimensional poverty index (MPI) approach, which is also referred to as the Alkire and Foster (2011) model or the Adjusted Headcount Ratio technique is used. This approach derives from revision of the Global multidimensional poverty index that was co-designed and launched in 2010 by the Oxford Poverty and Human Development Initiative (OPHI) in partnership with the UNDP (Jahan & Alkire, 2018). With the MPI, magnitude and nature of deprivation in education, health and living standards for each household are determined directly.

The MPI is calculated by multiplying average number of deprivations among the poor (the average deprivation shared among the multidimensionally poor (A)) and poverty headcount (the percentage of poor in the society (H)). That is, percentage of people who are multidimensionally poor, adjusted by average share of deprivations among the poor (intensity) (Jahan & Alkire, 2018). This is specifically expressed as:

MPI = M_0 = Intensity (A) * Incidence (H) .... **(7)**

The range of the computed multidimensional poverty index is between 0 and 1. Meanwhile, some households are below the poverty cut-off point of zero (0) even if their scores are non-negative; hence the variables are censored. Despite the significant revision of the Alkire and Foster model, the new global MPI still contains the same number of indicators, ten (10) which is organised into three dimensions with same dimensional and weighting structure (Jahan & Alkire, 2018). Table 1 summarises the deprivation cut-off points, weights, indicators and dimensions of multidimensional poverty of the agricultural household members.

Table 1: Dimensions, indicators, deprivation cut-offs and weights of MPI

Dimensions of poverty	Indicator	Deprived if...	Weight
Health	Nutrition	Any adult under 70 years of age or any child for whom there is nutritional information is undernourished.	1/6
	Child mortality	Any child has died in the family in the year period preceding the survey.	1/6
Education	Year of	No household member aged 10 years or older has completed six years of	1/6

	schooling	schooling.	
	School attendance	Any school-aged child is not attending school up to the age at which he or she would complete class 9 (JHS).	1/6
Living standard	Cooking fuel	The household cooks with dung, wood, charcoal.	1/18
	Sanitation	The household's sanitation facility is not improved (according to SDG guidelines), or it is improved but share with other households	1/18
	Drinking water	The household does not have access to improved drinking (according to SDG guidelines), or safe drinking water is at least a 30 minute walk from home, round trip.	1/18
	Electricity	The household has no electricity.	1/18
	Housing	At least one of three housing materials for roof, walls and floor are inadequate: the floor is of natural materials and or the floor and or walls are of natural or rudimentary materials.	1/18
	Asset	The household does not own more than one of the following assets: radio, TV, telephone, any form of computer, poultry/livestock, bicycle, motorbike, or refrigerator, land and does not own a car or truck.	1/18

Source: Authors' compilation

The *health* dimensions consider nutrition and child mortality as indicators, with each weighing one-sixth (1/6). A household is deprived if a child in a household has died in years preceding the survey, contrary to the five years of the revision of the approach. Similar to health, each indicator of *education* weighs one-sixth (1/6) while years of education are considered a proxy for quality of education, enrolment is considered as good indicator for exposing children of school-age to a learning environment. *Living standards* have six indicators of an equal weight of one-eighteenth (1/18). The indicators include housing, which considers roof type, outer wall type and floor type of the household; lighting, cocking fuel, source of drinking water, toilet facility; and Asset: durable and livestock (Agyeman-Boaten & Fumey, 2021). Alkire and Santo, 2011 posit that these standard of living indicators are means to an end and not end in themselves. Table 2 presents the brief description and measurement of the variables and their expected signs.

Table 2: Variable description, measurement and expected signs

Dependent Variables	Description and Measurement	Variable List	Expected Signs
Welfare	Multidimensional poverty index	GLSS_MPI	
Agriculture Household	Binary: outcome variable; 1, if household engages in agriculture and 0, if otherwise	AgricHH	
Work Status	Binary: 1, if household has a job and 0, if otherwise.	Jobbing	
Independent variables			
Household size	Continuous: Number of household members	nh	+
Sex of household head	Binary: 1, if household head is male and 0, if female	SEXHH	+/-
Age of household head	Continuous: natural log of the number of years the household head has lived	lnAgeHH	+
Marital status of household head	Categorical: marital status of household members; 1 Married 2 Consensual Union 3 Separated 4 Divorced 5 Widowed and 6 Never married	MarStaHH	-
Age Married of household head	Continuous: Age first married or living with a partner	AgeMarHH	-
Education level of	Categorical: Household head's educational level: 0=None;	HHEDU	-

household head	1=Kindergarten/Primary; 2=JSS/JHS/Middle; 3=SSS/SHS/Secondary/Voc/Tech/Comm/Teacher Training/Agric/Nursing Cert; 4=Tertiary		
Location of household	Binary: 1, if household is located in an urban area and 0, if in rural area.	Loc2	+
Ethnicity of household head	Categorical: ethnic group that the household head belongs	EthGHH	+/-

Source: Author's compilation based on literature

3.4. Source of data

The study uses the seventh edition of the Ghana Living Standard Survey (GLSS 7) from Ghana Statistical Service. The GLSS 7 sampled 15,000 households in 1,000 enumeration areas. The response rate was 93.3 percent, with 14,009 responded households. The dataset contains detailed information on variety of topics including education, employment, demographic characteristics, health, financial services, credit and assets. Others are migration and tourism, housing, household agriculture, expenditure and income, governance, peace and security among others (GSS, 2018). The main purpose of the survey was to provide a wealth of information for understanding living conditions and monitoring the welfare system in Ghana. The data was collected from 22nd October 2016 to 17th October 2017.

4. RESULT AND INTERPRETATION

3.5. Summary statistics

The summary statistics of variables for the study are presented in Table 3. Out of 96190 household members engaged in Agriculture, 70262 (approximately 73 percent) were males and 25928 (approximately 27 percent) were females. For the total of 191166 household members that do not engage in Agriculture, 117724 (approximately 62 percent) were males, and 73442 (approximately 38 percent) were females. It indicates that males dominate in both agriculture and non-agriculture sectors. However, females have a higher percentage in the agricultural sector than in the non-agricultural sector. Table 3 shows categories of household workers who engage in agriculture and otherwise.

Table 3: Agriculture engagement

Dependable Variable	Definition	Frequency	Percentage
	Agric Engagement		
Non-Agriculture	Male	117724	73
	Female	73442	27
Agriculture	Male	70262	62
	Female	99370	38
	Work Status		
Not Jobbing	Male	16046	44.67
	Female	19943	55.52
Jobbing	Male	171940	68.4
	Female	79427	31.6

	Obs	Mean	Std.Dev.	Min	Max
Welfare (GLSS_MPI)	720000	.354	.111	0	0.944

Source: Author's computation based on GLSS7 data

About 68 percent (171940) of male household members have a job, compared with 44.67 percent (16046) who do not have a job. On the other hand, 31.6 percent of females have a job, and 55.5 percent are without a job. This implies that more females are without a job in agricultural households than their male counterparts. Nonetheless, the percentage of males and females who do not have jobs is significantly high among agricultural households. In the Table 3, the outcome variable of the treatment effect model (welfare) has a mean (standard deviation) of 0.354 (0.111), which indicates a low average and a meagre variability of deprivation. Again, out of 177168, agriculture household members who had jobs, only 2336 (1.3 percent) were agriculture self-employed with employees and 104032 (59 percent) agriculture self-employed without employees. Household members who serve as agriculture contributing family workers were 60921 (34 percent) and the least being paid apprentices (55).
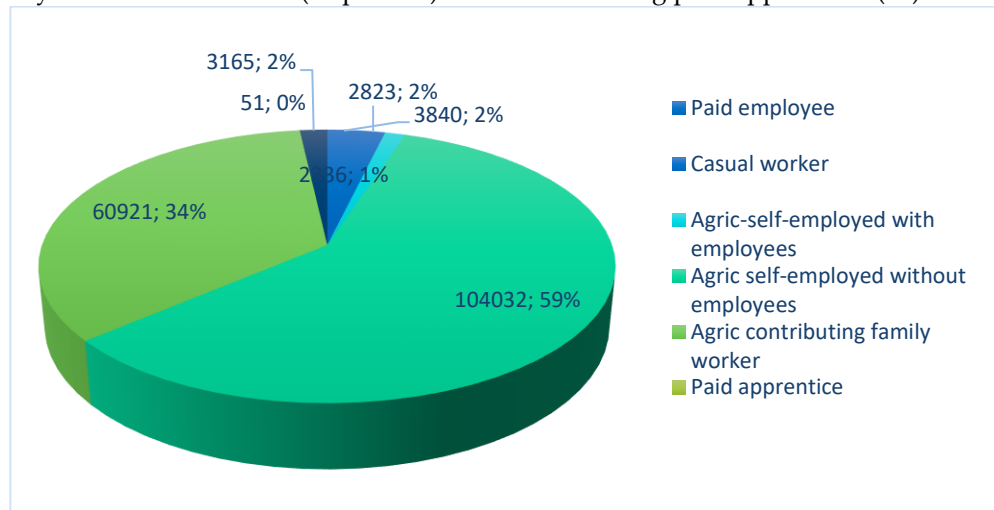

Figure 3: Agriculture Household Employees

Additionally, descriptive statistics of the explanatory variables are presented in Table 4. The household size is a count variable that ranges from one (1) to fifteen (15) with an average of about eight members. The sex distribution had a dummy of male (1) and female (2), with the average of 1.346 signifying more male than female household heads. Both age and the married age of the household heads are also count variables. The natural logarithm of age is used to determine the age of household heads. While the age of household heads ranges from 15 to 99 years, the age they first got married spans from a minimum of 10 years and a maximum of 99 years. However, the average age and marriage age of the agriculture household heads were 44.7 and 27.8 years, respectively. It implies that some household heads married as low as the age of 10. The highest education level of the household heads was a categorical variable ranging from no formal education (0) to tertiary (4). The mean of 2.343 signifies that on average, the household heads had completed basic school (JHS/JSS/Middle school). Location is a dummy variable representing urban (1) and rural (2). It has a mean of 1.572, which shows that many agricultural households are located in rural areas. Finally, the marriage status of the household head is a categorical variable ranging from 1 to 6 and serves as an exclusive variable in the selection model for this study.

Table 4: Descriptive statistics of explanatory variables

Variable	Obs	Mean	Std.Dev.	Min	Max
nh	720000	7.973	4.314	1	15
SEXHH	287000	1.346	.476	1	2
AgeHH	287000	44.678	17.256	15	99
HHEDU	222000	2.343	.958	0	4
loc2	720000	1.572	.495	1	2

EthGHH	283000	2.956	2.259	1	9
AgeMarHH	212000	27.802	16.888	10	99
MarStaHH	287000	3.356	2.106	1	6

Source: Author's estimation with *STATA 15* based on GLSS 7 dataset

4.2. Heckman probit estimate

Table 5 presents result of the Heckman probit estimations which consider sample selection for agriculture engagements. The dependent variable of the outcome model is households' participation in agriculture (AgricHH) and the dependent variable for the selection model is work status (Jobbing). After the Heckman probit selection regression, the magnitude of the effect of the determinants of household's engagement is determined by calculating the marginal effect of the factors that influence the agriculture participation. The correlation coefficient between the error terms of the two models is ρ= 0.846 indicating that the unobservable determinants affect work status positively in relation to the unobservable determinants that influence households' participation in agriculture. Also, the Wald test for the Heckman probit model (Model 3) reveals that the predictor variable explains both the outcome and the selection models. The likelihood ratio test of independence between the two models is P>ch2 = 0.000 indicating the statistical significance of the correlation coefficient. Therefore, the null hypothesis is rejected that there is no correlation between the two models. Given this rejection, it is appropriate to use the Heckman probit model over separate estimations for the two models. This result contradicts that of Biyase and Fisher (2017) where there is self-selection of households in the credit market, but similar to the study by Sakyi (2017) where there is no self-selection of households. In view of these inconsistencies from different estimations, it is suggested that separate standard probit estimations are carried out to estimate both models to compare results with the Heckman probit model.

Table 5: Standard probit and Heckman probit estimations

	(1) OPM	(2) SPM	(3A) HPM	(3B) HPM
nh (Household size)	0.006***	0.011***	0.007***	0.011***
	(0.001)	(0.001)	(0.001)	(0.001)
1bn.SEXHH (Male)				
2.SEXHH (Female)	-0.562***	-0.445***	-0.588***	-0.450***
	(0.009)	(0.011)	(0.009)	(0.011)
lnAgeHH (Age)	0.584***	-1.522***	0.784***	-1.538***
	(0.012)	(0.017)	(0.017)	(0.017)
0bn.HHEDU (No Education)				
1.HHEDU (Primary/Kin)	0.596***	0.929***	0.018	0.901***
	(0.063)	(0.054)	(0.070)	(0.054)
2.HHEDU (Middle/JSS/JHS)	0.277***	0.830***	-0.330***	0.791***
	(0.063)	(0.054)	(0.070)	(0.054)
3.HHEDU (SSS/SHS/Voc/Tech/Com)	0.020	0.722***	-0.577***	0.680***
	(0.063)	(0.055)	(0.071)	(0.055)
4.HHEDU (Tertiary)	-0.688***	0.751***	-1.283***	0.712***
	(0.064)	(0.055)	(0.072)	(0.055)
1bn.loc2 (Urban)				
2.loc2 (Rural)	1.275***	0.324***	1.310***	0.315***
	(0.008)	(0.010)	(0.009)	(0.010)
1bn.EthGHH (Akan)				
2.EthGHH (Ga-Adangme)	-0.077***	0.011	-0.096***	0.034**
	(0.015)	(0.017)	(0.016)	(0.017)
3.EthGHH (Ewe)	-0.186***	0.027**	-0.176***	0.038***

	(0.011)	(0.012)	(0.011)	(0.012)
4.EthGHH (Guan)	0.165***	0.179***	0.219***	0.202***
	(0.020)	(0.026)	(0.021)	(0.026)
5.EthGHH (Gruma)	0.398***	-0.255***	0.502***	-0.244***
	(0.023)	(0.031)	(0.024)	(0.031)
6.EthGHH (Mole-Dagbani)	0.167***	0.002	0.179***	0.047***
	(0.013)	(0.017)	(0.013)	(0.017)
7.EthGHH (Grusi)	0.160***	0.086**	0.115***	0.144***
	(0.025)	(0.034)	(0.025)	(0.034)
8.EthGHH (Mande)	0.327***	1.220***	0.334***	1.344***
	(0.042)	(0.174)	(0.042)	(0.170)
9.EthGHH (All other tribes)	-0.091**	-0.191***	-0.041	-0.167***
	(0.039)	(0.043)	(0.040)	(0.043)
AgeMarHH (Marriage age)	-0.002***	0.001**	-0.002***	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
1bn.MarStaHH (Married)				
2.MarStaHH (Consensual Union)		-0.186***		-0.159***
		(0.016)		(0.016)
3.MarStaHH (Separated)		-0.145***		-0.131***
		(0.016)		(0.016)
4.MarStaHH (Divorced)		0.025		0.052***
		(0.015)		(0.015)
5.MarStaHH (Widowed)		-0.076***		-0.042***
		(0.014)		(0.014)
_cons	-3.472***	6.240***	-3.613***	6.318***
	(0.080)	(0.089)	(0.091)	(0.089)
athrho:_cons			0.846***	0.846***
			(0.046)	(0.046)
Obs.	150297	150297	150297	150297
R-squared	.z	.z	.z	.z

Standard errors in parentheses *p < 0.1, **p < 0.05, ***p < 0.01

Source: Authors' estimation with *STATA 15* based on GLSS 7

4.2.1. Discussion on agriculture participation

The Heckman probit model (Model 3A) results show that agriculture engagement (AgricHH) is significantly influenced by all the variables used in the model except the household head with the highest education level to be primary or kindergarten and a household belonging to all other tribes originating from Ghana that not found in the eight main ethnic groups of Ghana. However, the standard probit estimation of the outcome model (Model 1) showed that all the variables used in the model significantly influenced agriculture engagement except the household head with the highest education level to be secondary. Based on the likelihood ratio test of independence between the two models, the Heckman probit (model 3A) is preferred to the standard probit and was used to analyse the factors determining agriculture engagement.

In the first place, participation in agriculture by households relates positively and significantly to the size of households. Thus, if a household size increases by one person, the probability of participation in agriculture increases by 0.7 percentage points. The positive coefficient indicates that a household that involves large household members tend to engage in agriculture and *vice versa*. This result supports the argument that many farmers give birth to more children in order to augment their labour force. The finding is consistent with Kolodinsky and Pelch (1997), who find a significant and negative relationship between households with kids.

Households headed by females are less likely to engage in agriculture than male-headed households by approximately 58.8 percentage points lower. This is a result of the negative relationship that exists between agriculture engagement and female-headed households. This finding explains the culture in many farming communities that males prepare the land through clearing, logging, and burning, among others, for their female counterparts to cultivate. Again, due to the labour-intensive nature of agriculture activities in Ghana, a household with a female head without a masculine figure would prefer to engage in other forms of occupations such as trading. This result also explains the GLSS finding by GSS that except for service and sales workers, and trade and related trade workers, male engagement in all occupations dominate that of their female counterparts, but in terms of poverty incidence in Ghana, households headed by females were found to be better-off than households headed by their male counterparts. However, Pattnaik et al. (2018) reiterates that the feminisation of agriculture is not due to women's social or economic empowerment but due to many other poverty factors.

The age of a household head significantly and positively relates to agriculture participation at a 1 percent level suggesting that ageing household heads are associated with high probability of participation in agriculture. As a result of the low incentive to engage in agriculture in Ghana, the youth who do envisage substantive reward of their labour after their engagement, most especially those who have attained some level of education, do not want to engage in agriculture but prefer white-colour jobs. Again, due to the notion of 'get rich quick', some also have resulted in illegal mining (a.k.a. Galamsey) to the detriment of farming and leaving the sector to the older generation who do not have an option to learn different trade.

Furthermore, except for education level up to the primary school, which is positive and not significant, all other levels are significant and negatively associated with agriculture engagement. This implies that as the head of household's educational level increases, probability of participation in agriculture decreases. The percentage points for household heads with middle or junior high level of education is 33 percentage points lower to the probability of engaging in agriculture than household heads without education. Heads of households with secondary and tertiary education have 57.7 and 128.3 percentage points lower probability respectively of engaging in agriculture relative to those with no education. This can as well be ascribed to the low labour incentive of the sector and it is confirmed by Kolodinsky and Pelch (Kolodinsky & Pelch, 1997).

The location of a household is identified to have significant influence on participation in agriculture. The significant positive relationships of the results suggest that rural households have 131 percentage points higher engagement in agriculture than households located in urban areas. The plausible reason for this result is that resources such as fertile lands and cheap labour among others abound in the rural areas to enhance agriculture participation other than in the urban areas.

On ethnicity, the result varies significantly among the ethnic groups in Ghana. For instance, while Ga-Adangme and Ewe groups have a negative relationship with participation in agriculture, Guan, Gruma, Mole-Dagbani, Grusi, and Mande have a positive relationship. The coefficient shows that Ga-Adangme households have lower probability of 9.6 percentage points of participating in agriculture than Akan households. Also, while Ewe ethnic groups have lower probability of 17.6 percentage points of participating in agriculture relative to the Akan groups, Guans have probability of 21.9 percentage points higher than Akan groups. Similarly, Gruma, Mole-Dagbani, Grusi, and Mande groups have 50.2, 17.7, 11.5 and 33.4 percentage points higher probabilities, respectively of participating in agriculture relative to the Akan group. This can be explained by their geographical locations within the country in that Ga-Adangmes and Ewes are primarily situated along the coastal areas where farming activities are not dominant compared to the Akan group which is located in predominantly located in the middle and forest zones of the country where farming is the main occupation. However, the other ethnic groups are mainly located in the northern territories of the country where farming is dominant job.

Finally, agriculture engagement is influenced by the age at which a household head first got married. The results show a negative relationship which implies that as age at first marriage of household heads increase, the

probability of engaging in agriculture decreases by 0.2 percentage points. This implies that household heads who marry in their older years are less likely to engage in agriculture. This seems to confirm the notion that people who choose acquire higher formal education tend to delay marriage and childbirth, and do not venture into agriculture.

4.2.2. Discussion on the determinants of work status

The results from the Heckman probit model show that work status (Jobbing) of a household heads (Model 3B) is significantly influenced by all the variables in the model at 1 percent level except the household that belongs to the Ga-Adangme ethnic group, which is significant at 5 percent level and the age at which a household head married which is only significant at 10 percent level. Conversely, in the probit estimation of the selection model, work status (Model 2) is significantly influenced by all the variables used in the model except the household that belongs to the Ga-Adangme and Mole-Dagbani ethnic groups as well as divorced household heads. Ewe and Grusi households, as well as age at first marriage of household heads are significant at a 5 percent level.

The Heckman probit model (Model 3B) estimates are preferred to the standard probit model in analyses of the work status factors. In particular, work status of household heads is positive and significantly influenced by household size indicating that as number of members in a household increase, probability of household heads working increases by 1.1 percentage points.

The results further indicate that female headed households compared to their male-headed counterparts are less likely to engage in any form of work by 45.0 percentage points lower. Thus, there exists a negative relationship between the work status and female-headed households. This outcome may be explained that African men are breadwinners while the women are responsible for taking care of the home as such men are considered first in terms of economic activities. De Boca and Locatelli (2006) explain that social policies including family background, time allocation within the household, religion, and culture account for this finding.

In addition, work status is negative and significantly influenced by the household head's age which suggests that as household heads grow in age, probability of work status decreases by 153.8 percentage points. This can be explained that as household heads advance in age they most of them go on pension and quit their economic activities due to lack of energy to participate in any job and ill health. This is consistent with the study by Dunga and Sekatane (Dunga & Sekatane, 2017).

The findings further indicate that all levels of education are positive and significantly related to work status meaning as household head's education levels increase, the probability of getting other jobs aside agriculture increases. The empirical evidence shows that while household heads with kindergarten or primary level education is 90.1 percentage points higher relative to household heads with no education in securing a job, household heads with middle or junior high school education have 79.1 percentage point higher probability. Similarly, household heads with secondary education compared to those with no education have 68.0 percentage point higher probability of getting other jobs. Household heads with tertiary education show higher probability of 71.2 percentage points of getting jobs relative to heads of household without education.

Additionally, the household location is also found to be positive and significantly related to the work status of household heads. The positive relationship indicates that households located in the rural areas have 31.5 percentage points higher probability of household members to be employed than households located in urban areas. A plausible explanation for this may be attributed to the availability of resources such as fertile land and low level of skills to engage in agriculture and other activities compared to educational qualification and work experience required in urban areas for service, manufacturing and white colour jobs.

The results also reveal that there exist positive and significant relationship between all the ethnic groups and work status of household heads except for Gruma and 'all other tribes'. Specifically, the marginal effects show that a Ga-Adangme household has 3.4 percentage points higher probability for a household head to have a job than an Akan household. Again, while the Ewe, Guans, Mole-Dagbani, and Grusi have 3.8, 20.2, 4.7, and 14.4 percentage

points higher probability for a household head to have a job than an Akan household, Gruma and 'all other tribes' have 24.4 and 16.7 percentage points, respectively higher than Akans. The Mande ethnic group has 134.4 percentage points higher probability for a household head to have a job relative to the reference ethnic group, Akan. This suggests that the head of a Mande household is more likely to be employed than all other ethnic groups.

Additionally, the results show that age at first marriage of household heads influences the their work status but significant at 10 percent level. Nonetheless, the study demonstrates a positive relationship. Hence, as the first marriage age of a household head increases, the probability that he/she has a job decreases by just 0.1 percentage points. This implies that household heads who marry at their older years are more likely to have jobs than those who marry at a younger age. A possible explanation could be that those who married at their older age prepared well to secure a permanent career before venturing into marriage. Dunga and Sekatane (2017) support this result with a theory showing a quadratic shape of income profile. They also accorded some reasons for age discrimination in the hiring process.

Finally, except household heads that are divorced which have positive relationships with work status, all other categories of marriage status are negatively influenced by the work status of the household heads and are all significant at a 1 percent level. In particular, consensual union, separated and widowed household heads have 15.9, 13.1 and 4.2 percentage points respectively lower to the probability of the household head to be employed than a married household head, divorced household heads which have 4.2 percentage higher to be employed. According to Dunga and Sekatane (2017), having a job is the only option for never-married to be independent as they have no spouse to depend on. This same reason can be said of the divorced household heads.

4.3. Propensity Score matching estimation

To estimate the propensity score matching we present a summary statistic of the variables under consideration for households' participation and non-participation in agriculture. This is presented in Table 6 below.

Table 6: Descriptive statistics of agriculture and non-agriculture participation

Variable names	Agriculture engagement (1) N=96190(33.5 percent)		Non-Agric engagement (0) N= 191166 (66.5 percent)		Diff in means
	Mean	SE	Means	SE	
Outcome Var.					
Welfare	0.3882153	0.0002502	0.3426227	0.0001507	-0.0455926
Independent Var.					
Household Size	8.063776	0.0102307	7.943599	0.0058584	-0.1201771
Sex	1.26955	0.0014307	1.384179	0.0011125	0.1146293
LnAgeHH	3.829545	0.0011554	3.672692	0.0008942	-0.1568526
Education	1.888719	0.0031532	2.50646	0.0023926	0.6177405
Location	1.877237	0.000779	1.472385	0.0006779	-0.4048519
Ethnicity	3.497494	0.007583	2.683412	0.0049962	-0.8140827
Age Married	29.09184	0.0691941	26.9557	0.0401091	-2.136142
Marital Status	2.800603	0.0062815	3.634914	0.0048642	0.8343112

Source: Authors' computation with *STATA 15* from GLSS7 data

Note: Diff = mean (1) - mean (0). Treatment variable = Agriculture participation

Table 6, summarises the characteristics of households who engage in agriculture and those who do not engage in agriculture. From the table, it can be found that the outcome and independent variables show some differences between the means of households that engage in agriculture and those that did not. For a sample of 287,356 household members that had jobs, 96,190 (33.5 percent) engage in agriculture and serve as the treatment group. The

mean welfare of households that engage in agriculture is 0.388, and those who do not engage in agriculture is 0.343. This implies that households that engage in agriculture on average are multidimensionally deprived than those that do not. Hence, the welfare of households that engage in agriculture is lower than those that engage in other forms of employment.

The impact of agriculture participation as the treatment dependent variable is estimated on the outcome variable which is the welfare of household's participation in agriculture. The treatment independent variables include marital status of household heads, age and sex of household heads, age of household heads at first marriage, size of household, location, ethnicity and educational levels of household heads.

For propensity score matching, the probit model is employed for the analysis. The average treatment effect (ATE) estimates of the population are statistically significant at the 1 per cent level. This implies agriculture participation has an impact on multidimensional welfare of households that participate in agriculture. The result further shows that welfare measured in terms of multidimensional poverty of participating in agriculture by households are on average 0.030 percentage points more deprived than non-agriculture participating household counterparts (see Table 7). The finding is consistent with reports of the Ghana Statistical Services on poverty incidence of households in Ghana. The report indicates that poverty incidence is highest (42.7 per cent) among households engaged in agriculture self-employment from the GLSS 5 to 7 and households in private employment. On the other hand, households engaged in agriculture and the self-employed in non-agricultural sectors are less likely to be poor.

Table 7: Propensity score matc.hing treatment-effects estimates

	ATE	ATET
	Welfare	Welfare
Impact of households Agriculture participation		
(Agric and Non-Agric)	0.030***	0.032***
	(0.003)	(0.006)
Observations	39,274	39,274
Treated (Agric)	1	1
	0	0
Control (Non-Agric)		

NB: Standard errors in parentheses; *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Source: Authors' estimations from GLSS7 data

The average treatment effects (ATE) is estimated using a logistic regression and the results is significant at the 1 percent level. This means that agriculture participation significantly impacts on the multidimensional welfare of households engaged in agriculture. It further reveals that the multidimensional welfare of households engaged in agriculture is on average 0.032 points deprived than if they had not engaged in agriculture. The impact of participating in agriculture on the multidimensional welfare of households is also estimated by using the Nearest-Neighbour Matching and Inverse-Probability Weighting Treatment Effect techniques. The results of these two techniques as presented in appendix A and B indicate that the impact of agriculture participation on welfare of households is positive and significant at a 1 percent level.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study examined the welfare impact of households' participation in agricultural activities in a multidimensional way and the factors that influence the participation. The findings of the study indicate that the welfare of households engaged in agriculture is multidimensionally deprived relative to agricultural non-participation of households. The main determining factors include sex and age of household heads, age at first marriage of household heads, size of household, location of household, ethnicity, education level and marital status

of household heads. In specific, the result shows that households are more likely to participate in agriculture if they are located in rural areas. Also, age of household heads and size of household tend to increase the probability of participating in agriculture than non-participation. On the other hand, a household is less likely to participate in agriculture if age at first marriage of household heads increases and this is the case for female-headed households as well.

In addition, except for the education levels up to primary and kindergarten which are not statistically significant; all other levels of education are less likely to participate in agriculture activities in Ghana due to the low incentives in the sector. Aside from making agriculture compulsory in the educational curriculum by the education ministry to motivate students to take agriculture as a career and pursue it as "agripreneurship", other initiatives to increase youth participation should be implemented by the Government through the creation of enabling environment. These interventions may be in the form of seed money, provision of modern agriculture technologies, improving upon land tenure system to minimise litigations by the judiciary, skills training and timely provision of inputs at affordable prices by ministry of agriculture among others. The provision of enabling environments by the government may include ready market and guaranteed prices for the agriculture produce as well as infrastructure and social amenities in the rural areas where agriculture is the main occupation and all these would greatly improve the living standards household engaged in agriculture, particularly the rural ones.

ORCID

Abel Fumey https://orcid.org/0000-0002-9477-9822

References

Abass, K., Afriyie, K., & Adomako J. A. (2013). Household responses to livelihood transformation in peri-urban Kumasi. *Journal of Sustainable Development*, 6(6), 121 – 136. DOI: https://doi.org/10.5539/jsd.v6n6p121.

Abay, K. A., Asnake, W., Ayalew, H., Chamberlin, J., & Sumberg, J. (2021). Landscapes of opportunity: patterns of young people's engagement with the rural economy in sub-Saharan Africa. *The Journal of Development Studies*, *57*(4), 594-613.

Agyeman-Boaten, S. Y., & Fumey, A. (2021). Effects of cocoa swollen shoot virus disease (CSSVD) on the welfare of cocoa farmers in Ghana: evidence from Chorichori community of the Sefwi Akontombra district. *SN Business & Economics*, *1*(11), 1-31.

Alkire, S., & Santos, M. E. (2011). Poverty and Inequality Measurement‖, in S. Deneulin and L. Shanai (eds.) An Introduction to the Human Development and Capability Approach, Abingdon, Earthscan Ltd.

Alkire, S., & Foster, J. (2011). Understandings and misunderstandings of multidimensional poverty measurement. *The Journal of Economic Inequality*, 9(2), 289-314.

Alkire, S., & Jahan, S. (2018). The New Global MPI 2018: Aligning with the Sustainable Development Goals. OPHI Working Paper 121, Oxford: University of Oxford.

Alston, A. J., Roberts, R., & English, C. W. (2020). Toward a holistic agricultural student recruitment model: A national analysis of the factors affecting students' decision to pursue an agricultural related degree. *Journal of Research in Technical Careers*, *4*(1), 1.

Bärnighausen T., Bor J., & Wandira-Kazibwe S, (2011). Correcting HIV prevalence estimates for survey nonparticipation using Heckman-type selection models. Epidemiology; 22, 27-35.

Becker, S. O., & Ichino, A. (2002). Estimation of Average Treatment Effects based on Propensity Scores. *The Stata Journal*, 2(4), 358-377.

Binswanger, H. P. & Quizon, J. B. (1989). *What can agriculture do for the poorest rural groups?* (Report No. 57). Washington, DC: Agricultural and Rural Development Department, World Bank.

Biyase, M., & Fisher, B. (2017). Determinants of access to formal credit by the poor households. *Studia Universitatis Babes-Bolyai*, *62*(1), 50.

Bravo-Ortega, C., & Lederman, D., (2005). *Agriculture and National Welfare Around the World: Causality and International Heterogeneity Since 1960.* Available at:
https://openknowledge.worldbank.org/bitstream/handle?

Bushway, S., B. D. Johnson, and L. A. Slocum. (2007). Is the magic still there? The use of the Heckman two-step correction for selection bias in criminology. *Journal of Quantitative Criminology* 23, 151–78.

Chaix B., Billaudeau, N., Thomas, F., Havard, S., Evans, D., Kestens, Y., & Bean, K., (2011). Neighborhood effects on health: correcting bias from neighborhood effects on participation. *Epidemiology*, *22*(1), pp.18-26

Clark, S. J., & Houle B. (2014). Validation, Replication, and Sensitivity Testing of Heckman-Type Selection Models to Adjust Estimates of HIV Prevalence.   https://doi.org/10.1371/journal.pone.0112563

Cobb-Clark, D. A., & Crossley T. (2003). Econometrics for Evaluations: An Introduction to Recent Developments. *Economic Record*, 79(247), 491 -511

Coxhead, I. A., & Warr, P. G. (1991). Technical change, land quality, and income distribution: A generalequilibrium analysis. *American Journal of Agricultural Economics*, *73*(2), 345 - 360.

Cuddeback, G., Wilson , E., Orme, J. G., & Combs-Orme, T. (2004). Detecting and correcting sample selection bias. *Journal of Social Service Research, 30*(3), 19–33.

Datt, G., & Ravallion, M. (1996). Farm productivity and rural poverty in India. *Journal of Development Studies*, *34*(4), 62-85.

Davis, B., Giuseppe, S. D. & Zezza, A., (2017). Are African households (not) leaving agriculture? Patterns of households' income sources in rural Sub-Saharan Africa. *Food Policy*, Volume 67, 153-174.

De Franco, M., & Godoy, R. (1993). Potato-led growth: The macroeconomic effects of technological innovations in Bolivian agriculture. *Journal of Development Studies*, *29*(3), 561-587.

Del Boca, D., & Locatelli, M. (2006). The determinants of motherhood and work status: A survey. IZA, Institute of Labor   Economics Discussion Papers, No. 2414.

Dimelu, M. U., Umoren, A. M., & Chah, J. M. (2020). Determinants of Youth Farmers' Participation in Agricultural Activities in Akwa Ibom State, Nigeria. *Journal of Agricultural Science*, *12*(12), 201-212.

Dunga, S. H., & Sekatane, M. B. (2014). Determinants of employment status and its relationship to poverty in Bophelong Township. *Mediterranean Journal of Social Sciences*, *5*(21), 215-215.

FAO, (2001). *Food and Agriculture Organization of the United Nations, Ghana at a glance.* Available at:
http://www.fao.org/ghana/fao-in-ghana/ghana-at-a-glance/en/

Fergusson, D. M., Hong, B., Horwood, J., Jensen, J., & Travers, P. D. (2001). Living standards of older New Zealanders: A   summary. Ministry of Social Policy.

Francesconi, G. N., & Heerink, N. (2011). Ethiopian agricultural cooperatives in an era of global commodity exchange: does organisational form matter?. *Journal of African Economies*, *20*(1), 153-177.

Gallup, J., Radelet, S., & Warner, A. (1998). *Economic Growth and the Income of the Poor.* Cambridge, Harvard Institute for International Development.

Greene, W. H. (1995). Sample selection in the Poisson regression model. Working Papers 95-06, New York University, Leonard N. Stern School of Business, Department of Economics.

Greene, W. H. (2000). *Econometric analysis*. Pearson Education, India.

GSS (Ghana Statistical Service). 2018. Ghana Living Standards Survey Round 7 (GLSS7). Poverty Profile in Ghana (2005–2017).

GSS (Ghana Statistical Service). 2019. Ghana Living Standards Survey Round 7 (GLSS7). Main Report.

GSS (Ghana Statistical Service). 2020. Rebased 2013-2018 Annual Gross Domestic Product. April 2019 Edition.

Hanmer, L., & Naschold, F. (2000). Attaining the international development targets: Will growth be enough? *Development Policy Review*, *18*(1), 11-36.

Heckman, J. J. (1979). Sample selection bias as a specification error. Econometrica, 47 (1), 153-161

Irz, X., Lin, L., Thirtle, C., & Wiggins, S. (2001). Agricultural productivity growth and poverty alleviation. *Development Policy Review*, *19*(4), 449-466.

Keele, L. (2010). An overview of rbounds: An R package for Rosenbaum bounds sensitivity analysis with matched data. *White Paper. Columbus, OH, 1*, 15.

Kinyanjui, B., Araar, A., Barasa, L., Maende, S., & Mariera, F. (2019). *Off-Farm Participation, Agricultural Production and Farmers' Welfare in Tanzania and Uganda* (No. 2019-01). Canada: Working Paper.

Kolodinsky, J. M., & Pelch, L. L. (1997). Factors influencing the decision to join a community supported agriculture (CSA) farm. *Journal of sustainable agriculture, 10*(2-3), 129-141.

Martey, E., Etwire, M. P., & Abdoulaye T. (2020). Welfare impact of climate-smart agriculture in Ghana: Does row planting and draught-tolerant maize varieties matter?. *Land Use Policy*, 95, June 2020, 104622.

Martey, E. (2018). Welfare effect of organic fertilizer use in Ghana. *Heliyon*, *4*(10), 00844.

McCall, M., & Kaplan, R. (1985). *Whatever it takes: Decision-makers at work.* Englewood Cliffs: Prentice-Hall.

Mellor, J. (1999). *Faster, more equitable growth – The relation between growth in agriculture and poverty reduction agricultural policy development project* (Research Report No. 4). Washington, D.C.: United States Agency for International Development

Morrissey, K., Kinderman, P., Pontin, E., Tai, S., & Schwannauer, M. (2016). Web based health surveys: Using a Two Step Heckman model to examine their potential for population health analysis. *Social Science & Medicine, 163*, 45-53.

Mossie, M., Gerezgiher, A., Ayalew, Z., & Nigussie, Z. (2021). Welfare effects of small-scale farmers' participation in apple and mango value chains in Ethiopia. *Agrekon*, 1-17.

Otsuka, K. (2000). Role of agricultural research in poverty reduction: Lessons from the Asian experience. *Food Policy* 25: 447- 62.

Owusu, E. S., Namara, R. E., & Kuwornu, J. K. (2011). The welfare-enhancing role of irrigation in farm households in northern Ghana.

Pattnaik, I., & Lahiri-Dutt, K. (2020). What determines women's agricultural participation? A comparative study of landholding households in rural India. *Journal of Rural Studies*, *76*, 25-39.

Pattnaik, I., Lahiri-Dutt, K., Lockie, S., & Pritchard, B. (2018). The feminization of agriculture or the feminization of agrarian distress? Tracking the trajectory of women in agriculture in India. *Journal of the Asia Pacific Economy*, *23*(1), 138-155.

Ravallion, M., & Datt, G. (1996). How important to India's poor is the sectoral composition of economic growth? *The World Bank Economic Review*, *10*(1), 1.

Rosenbaum, P. R. (2002). Overt bias in observational studies. In *Observational studies* (pp. 71-104). Springer, New York, NY.

Rosenbaum, P. R., & Rubin, D.B. (1985). Constructing a Control Group Using Multivariate Matched Sampling Methods that Incorporate the Propensity Score. *The American Statistician*, 39: 33-38.

Rosenbaum, P. R., & Rubin, D. B. (1983). The Central Role of the Propensity Score in Observational Studies for Causal Effects. *Biometrica* 70(1): 41–55.

Samuel Sekyi, (2017). Rural Households' Credit Access and Loan Amount in Wa Municipality, Ghana, *International Journal of Economics and Financial Issues*, 7(1), 506-514.

Schneider, K., & Gugerty, M. K. (2011). Agricultural productivity and poverty reduction: Linkages and pathways. *The Evans School Review.* 1(1), 56-74.

Sherlund S. M., Barrett C. B., & Adesina A. A. (2002). Smallholder technical efficiency controlling for environmental production conditions. *Journal of Development Economics* 69(1),85-101.

Thirtle, C., Lin, L, & Piesse, J. (2003). The impact of research-led agricultural productivity growth on poverty reduction in Africa, Asia and Latin America. *World Development*, *31*(12), 1959-1975.

Thirtle, C., Irz, X., Lin, L, Mckenzie-hill, V., & Wiggins, S. (2001). *Relationship between changes in agricultural productivity and the incidence of poverty in developing countries* (Report No. 7946). London: Department for International Development.

Thorbecke, E., & Jung, H. S. (1996). A multiplier decomposition method to analyse poverty alleviation. *Journal of Development Economics 48*(2): 279-300.

Timmer, P. (1995). Getting agriculture moving: Do markets provide the right signals? *Food Policy 20*(5): 455–472.

Vella, F. (1998). Estimating models with sample selection bias: a survey. *Journal of Human Resources*, 127-169.

Wodon, Q. (1999). *Growth, poverty and inequality: A regional panel for Bangladesh* (Policy Research Working Paper 2072). Washington, DC: World Bank.

World Bank (2017). *Ghana Agriculture Sector Policy Note: Transforming Agriculture for Economic Growth, Job Creation and .Food Security*. World Bank, Washington, DC. Available at: https://openknowledge.worldbank.org/handle/10986/28394

World Bank. (2007). *World development report 2008: Agriculture for development*. Washington, D.C.: World Bank.

Appendices

Appendix A: Nearest-neighbour matching treatment-effects estimation

	ATE	ATET
	Welfare	Welfare
Impact of household Agriculture engagement	0.024***	0.014***
(Agric and Non-Agric)	(0.003)	(0.004)
Observations	39,274	39,274
Treated (Agric)	1	1
Control (Non-Agric)	0	0

Standard errors in parentheses *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Source: Author's estimation with *STATA 15* based on GLSS 7 dataset

Appendix B: Inverse-probability weights treatment-effects estimation

	ATE	ATET
	Welfare	Welfare
Impact of household Agriculture engagement	0.024***	0.021***
(Agric vs Non-Agric)	(0.001)	(0.001)
	POmean	POmean
(Agric vs Non-Agric)	0.345***	0.353***
	(0.0006)	(0.001)

Observations	39,274	39,274
Treated	1	1
Control	0	0

Standard errors in parentheses *p < 0.1, ** p < 0.05, *** p < 0.01

Source: Author's estimation with *STATA 15* based on GLSS 7 dataset