Sustainable Agricultural Intensification Practices and Rural Food Security: The Case of North Western Ghana

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Abstract

Purpose – The purpose of this paper is to understand the impact of participation in sustainable agricultural intensification practices (SAIPs) on household food security status in North Western Ghana.

Design/methodology/approach – The study utilized the Household Food Insecurity Access Scale (HFIAS) indicator for the measurement of food access data from 168 households in 10 communities from the North Western region of Ghana for the analyses. Households were categorized into participating households (treatment) and non-participating households (control). The endogenous treatment effects model was employed to evaluate the impact of participation on SAIPs training on food insecurity access scale.

Findings – The results show that participation in SAIPs training lower on average the household food insecurity access by 2.95, approximately an 11% reduction in HFIAS score. Other significant factors found to influence household food insecurity access scale are age of household head, experience in farming, total acres owned by household, income level of the household and occupation of the head of the household.

Research limitations/implications – The training programme of participation in sustainable agricultural intensification practices (SAIPs) has massive implications for food security, rural economy and farmers' livelihoods. However, due to the unique conditions prevailing in North Western Ghana, the findings of this research is limited in terms of its generalizability. Future research direction in the area of SAIPs trainings and impact study replications in all qualifying rural food production areas in Ghana, that are susceptible to household food insecurity, will provide a national picture of the efficacy of SAIPs trainings on household food insecurity.

Practical implications – A proven means to decrease natural resource degradation, increase crops yields, and increase subsistence farmers' income, and food security is an important intervention to resolve the seasonal food shortage, which last for five months in a typical year for agro-food dependent farming communities in North Western Ghana.

Social implications – Ensuring household food security improvement and environmental sustainability will help improve living standards of food producers and reduce the adverse social challenges associated with food insecure communities such as health problems due to food deficiencies, social inequalities, environmental pollution and natural resource degradation in North Western Ghana.

Originality/value – The contribution of this paper is the novel thought and approach to examine the impact of the SAIPs trainings on household food security in north western Ghana using the

household food insecurity access scale indicator. The study also examined the factors that affect household food security using the endogenous treatment model, which also evaluates the impact of the training programme on the outcome variable.

Keywords: Food security, Sustainable Agricultural Intensification Practices, Endogenous model, North Western Ghana.

1 Introduction

Farmers in northwestern Ghana practice subsistence agriculture with low soil productivity due to continuous mono-cropping with limited external farm inputs such as advanced seeds, chemical fertilizer etc. This situation is exacerbated by the lack of access to credit market, poor physical infrastructure, underdeveloped agricultural market, and poverty. These factors hinder the subsistence farmers' access to food, which make their households food insecure. Taken a cue from the earlier failed attempt in Ghana, Sustainable agricultural intensification practices (SAIPs) have been introduced in northwestern Ghana in 2010, in a research phases, as potential interventions to decrease natural resource degradation, increase crops yields, and increase subsistence farmers' income, and food security (Dalton *et al.*, 2014).

The debate as to what sustainable agriculture is among agricultural practitioners (Peterson and Snapp, 2015) is ongoing but the FAO definition is still popular with both researchers and practitioners. According to FAO (2009) sustainable agricultural intensification is defined as "the management and conservation of the natural resource base, and the orientation of technological and institutional change to ensure the attainment and continued satisfaction of human needs for present and future generations".

Food security is a growing concern in the world, particularly in developing countries. Among many definitions of food security, the World Food Summit of 1996 defines a situation "when all people at all times have access to sufficient, safe, and nutritious food to maintain a healthy and active life." This definition covers both physical and economic access to food that meet people's dietary needs and their food preferences. In general, food security is based on three pillars: food availability, food access, and food utilization. Food availability refers to sufficient amount of food is available on a regular basis. Food access refers to having sufficient resources to receive appropriate food for a nutritious diet whereas utilization refers to how properly individual uses

the food to which they have access. Utilization primarily focuses on dietary quality, related with inadequate intake of necessary vitamins and minerals for a healthy life (Barrett, 2010). Food insecurity affects food intake in quantity and quality, and eventually affect nutritional status and health of households (Mwaniki, 2006).[1]

More than 60% of the population in sub-Saharan Africa depends on agriculture and about 30% of the total population leave below the poverty line in Ghana (UNDP, 2005). The northern, upper east, and upper west regions of Ghana have been described as the home for mostly food insecure people (GLSS, 2000). The people of northern and upper west regions experience seasonal food shortage and do not have adequate food for five months in a typical year (Quaye, 2008). Ghana living standard survey and UNDP reports have consistently shown that food insecurity is a big challenge in Ghana, particularly in northern Ghana.

The main objective of this study is to evaluate the impact of household participation in sustainable agriculture intensification practices (SAIPs) on household food insecurity (access) in northwestern Ghana. The SAIPs programme was introduced in the region in 2010 to increase soil productivity, yield and farmers' income. Many studies have examined the status of food security elsewhere in Africa (Poppy *et al.,* 2014; Saaka and Osman, 2013; WFP, 2012; Reardon, Matlon, and Delgado, 1988; Barrett and Maxwell, 2006; Barrett, 2006). Most of these studies focused on examining the impact of socioeconomic, income, and farm characteristics on food security. The contribution of this paper is the novel thought and approach to estimate the impact of participation in sustainable conservation agricultural practices on food security using the household level survey data. This work complements those few studies that have considered the issues of food security associating with human and natural resources, health and investment factors such as the work of Rosegrant and Cline (2003), which links innovations in agro-ecological approaches and crop breeding to improve food security. Our evidence also complements the study of Quaye (2008), which examined the coping strategies of households during food insecure periods in Ghana.

[1] Note that adequate availability of food is necessary, but it does not ensure access to sufficient, safe, and nutritional food. For further explanation see Barrett (2010); UNDP (2005). Income, prevailing prices, and formal or informal safety net arrangements through which people can have access to available food affect food security.

2 Literature Review

This section provides background information on sustainable agriculture, food security situation in Africa, focusing on Ghana. It also describes factors that influence food security including past studies in the areas of conservation agriculture and food security.

2.1 Sustainable Agriculture Intensification Practices (SAIPs)

Sustainable agriculture intensification practices (SAIPs) involve components like direct seeding without prior ploughing with either a plough or a hoe, leaving crop residue or planting of cover crops and inter-cropping or crop rotation with legumes. The reasons for using SAIPs are to reduce the rate of declining soil fertility, improve soil structure, prevent soil erosion, and allow for sustained soil fertility (FAO, 2009). The benefits of these practices are the significant reduction of production cost (Dalton *et al.,* 2014) and increased yields (Balota et al., 2004; Bayala et al., 2012).

The extant literature suggests that sustainable agricultural intensification has helped communities improve their forest resources through community management in Mali (Tappan and McGahuey, 2005). Ndiritu *et al.,* (2014) found no significant socioeconomic inequalities exist among gender difference in the adoption of n of components sustainable agricultural intensification in Kenya. According to Gadanakis *et al.,* (2015), the concept of sustainable agricultural needs a holistic approach in integrating all the resource endowment of the farm household and the community as whole. This is evident as agrobiodiversity is found to support sustainable agricultural intensification (Omer *et al.,* 2010)

SAIPs are widely practiced by the United States with about 26 million hectares under the conservation agriculture practices (CAPs) followed by Latin America with about 26 million hectares (representing 16.5% of total cultivable land in 2007) and China is in a position to practice SAIPs in larger hectares (FAO, 2009). However, the uptake of the technology in sub-Sahara Africa is very low with less than 1 million hectares, which is about 0.3 % of the total cultivable land (FAO, 2009). It is worth noting that SAIPs were introduced first introduced in Ghana by GTZ and Monsanto in the early 1996 (Boahen, 2007). Constraints to SAIPs uptake in developing countries are attributed to non-availability of cash to farmers to purchase external

inputs and machines, lack of appropriate loose straw management, high cost of no-till drills and lack of adequate extension services (Singh *et al.,* 2008). Huggins and Reganold, 2008, also reported on the high cost of zero-till equipment, use of residue for animal feed and fuel are some of the factors hindering the adoption of zero-till in low income countries. In Ghana, lack of cover crop seeds, lack of appropriate tools, limited promotion and little or no institutional support were reported as challenges to no till adoption (Boahen, 2007).

The SAMREM CRSP project introduced SAIPs through an intensive participatory research process considering the socio-economic and farm level adaptation trial to enhance farm household knowledge in the project beneficiary communities in 2009. This was aimed at demystifying the perceptions held and to promote the use of SAIPs for sustained benefits to both household food security improvement and the environmental sustainability.

2.2 Food Security in Africa

Food security is a big challenge in developing countries, especially in Africa due to an underdeveloped agricultural sector, lack of market access, disease and infection in crops, lack of physical infrastructure, and so forth. Food insecurity is amplified in rural areas by seasonality, especially for perishable goods. Food security has worsened in Africa since 1970 and about 33 to 35% of the population in sub-Saharan Africa has the problem of malnutrition (Mwaniki, 2006). Nearly 240 million people in sub-Saharan Africa (about 25% of the total population) do not have adequate food for healthy and active life (Bremner, 2012). In spite of some advances, most of the regions are not on right path to achieve the Millennium Development Goals (MDGs). Food security is one of the primary objectives of MDGs with the goal of eradicating extreme poverty and hunger (UNDP, 2015). Some of the key factors that affect food security in Africa are explained as follow:

2.2.1 Underutilized Agricultural Sector

It is common knowledge that due to poor financial and educational status, households use minimum amount of external farm inputs such seeds, fertilizers and chemicals which decrease the productivity of land. During pre and post-harvest, farmers lose significant amount of food

crops due to inappropriate harvesting procedures. Because of inadequate food storage, they face high price fluctuation. During harvest time, in general, prices reach to the minimum level of a year, when farmers can sell their crops, but when they need to buy food, they have to pay higher prices. For example, farmers in rural area of Burkina Faso purchase foods in the hot and rainy seasons before harvest. Most of the households buy some foods, but those households with the poorest cropping outcomes are required to buy food more often (Reardon, *et al.,* 1988).

About 95% of crops are grown under rain fed agriculture in sub-Saharan Africa. The high dependency of agriculture on weather makes them more food insecure if the weather is unfavorable during plantation and harvest periods (Mwaniki, 2006). Food insecurity can be either short term (e.g. starvation due to a crop failure) or chronic (long term malnutrition). The chronic food insecurity is widespread in the regions under current research consideration and it is mainly caused by underdeveloped agricultural sector, unfavorable government policies, lack of market access etc. (Weber *et al.,* 1988). These farmers have no or very limited access to international markets because they have to meet some standards such as size, quantity, and quality.

Government policies may improve the agricultural sector making favorable policies to poor farms and developing pro-poor institutions. However, the problem in Africa is that even if governments make policies, these policies are not based on empirical information and so these policies are not effective in reducing food insecurity (Weber *et al.,* 1988).

2.2.2 Health Situations

Diseases like malaria, tuberculosis, HIV/AIDS also increase food insecurity in the developing world. HIV/AIDS is one of the leading causes of adult mortality and morbidity in Africa (Mwaniki, 2006). The household member affected by disease leads to reduction in the working hours, which increases burden to achieve quantity and quality of food. In addition, the disease affected household may severely go into the chronic food insecurity due to the need for higher nutritional food, but reduction in working hours.

2.2.3 Impact of Globalization and Liberalization

African countries also receive benefits from globalization. The benefits obtained from globalization are capital flows, technology transfer, cheaper import, and expansion of export

markets. However, poor families cannot receive benefits from globalization or liberalization of the market because liberalization increases competition with matured firms or industry from the developing and developed countries on local area. The subsistence farm or cottage industry cannot compete with matured industries, which again lead them into food insecurity.

Food security in rural Africa and for that matter Ghana cannot be analyzed without including socio-economic factors such as social protection, sources of income, household structures, access to land, water, and farm inputs, market access, nutritional knowledge among others. Multiple factors affect food security, which has not been understood in rural Ghana and this negatively impacts the effectiveness of government policy to decrease poverty and food insecurity. There are not enough institutional developments to use government policies to increase food security due to weak relationships among government, the private sector, and civil society organization (Altman, *et al.,* 2009).

Most of the African governments give high priority to decrease poverty and hunger, such as the South African government set objective to decrease poverty by 50% from 2004 to 2014 and food security is a crucial component in meeting the objective. The expansion of the social grants in South Africa has decreased chronic huger, but still under-nutrition is a big issue (Altman, et al. 2009). Likewise, World Food Programme (WFP) and Ministry of Food and Agriculture of Ghana conducted the 2012 Comprehensive Food Security and Vulnerability Analysis (CFSVA) survey on the three Northern regions of Ghana focusing on food insecurity and causes of food insecurity. The CFSVA results indicate that more than 680,000 people (about 2.72% in the three Northern region of Ghana what percentage of the population does this represents) were considered either severely or moderately food insecure in April/May 2012 and about 20% of the food insecure people had a very poor diet. Moreover, poor households with smaller farms, female-headed households, and households with an uneducated head are more food insecure than other households WFP (2012).

Saaka and Osman (2013) examined the magnitude of household food insecurity and its consequences on the nutritional status of children in northern Ghana. They find that children in food secure households are 46% more protected from chronic malnutrition than children in food insecure households. Their results suggest that improving adequacy of the diet could reduce chronic malnutrition in the region. Similarly, Quaye (2008) examines food security situation in

terms of household's food availability and the coping strategies of the households during food insecure periods in the three regions of northern Ghana. During the food insecure periods, these households depend on wild foods, market purchases, in-kind (food) payment from relatives and friends, migration and wage labour. Likewise, Reardon, *et al.,* (1988) examine strategies to ensure food security in Sahleian and Sudanian zones of Burkina Faso during the period of drought of 1984 and 1985 using primary income and consumption survey data. These households receive significant income from non-cropping occupations. Food consumption of smaller farm households is clearly different than own-production and the gap is fulfilled by food purchases in the both regions. This implies that availability of food does not ensure food security for poor families.

3 Conceptual and Empirical Approaches

The conceptual framework for food security follows multiple levels (individual, households, and community) and it associates food security to political, institutional, and environmental dynamics of the analysis. Food security is often an outcome of livelihood strategies. These strategies are based on available assets (e.g. human, social, natural, physical, and capital resources) to households. Livelihood strategies help cope with and recover from stresses and shocks, maintaining the use of resources both now and in the future. For example, the livelihood strategies in Ghana are crop production, livestock keeping, and trade (WFP, 2012). The conceptual framework for food security is presented in figure 1.

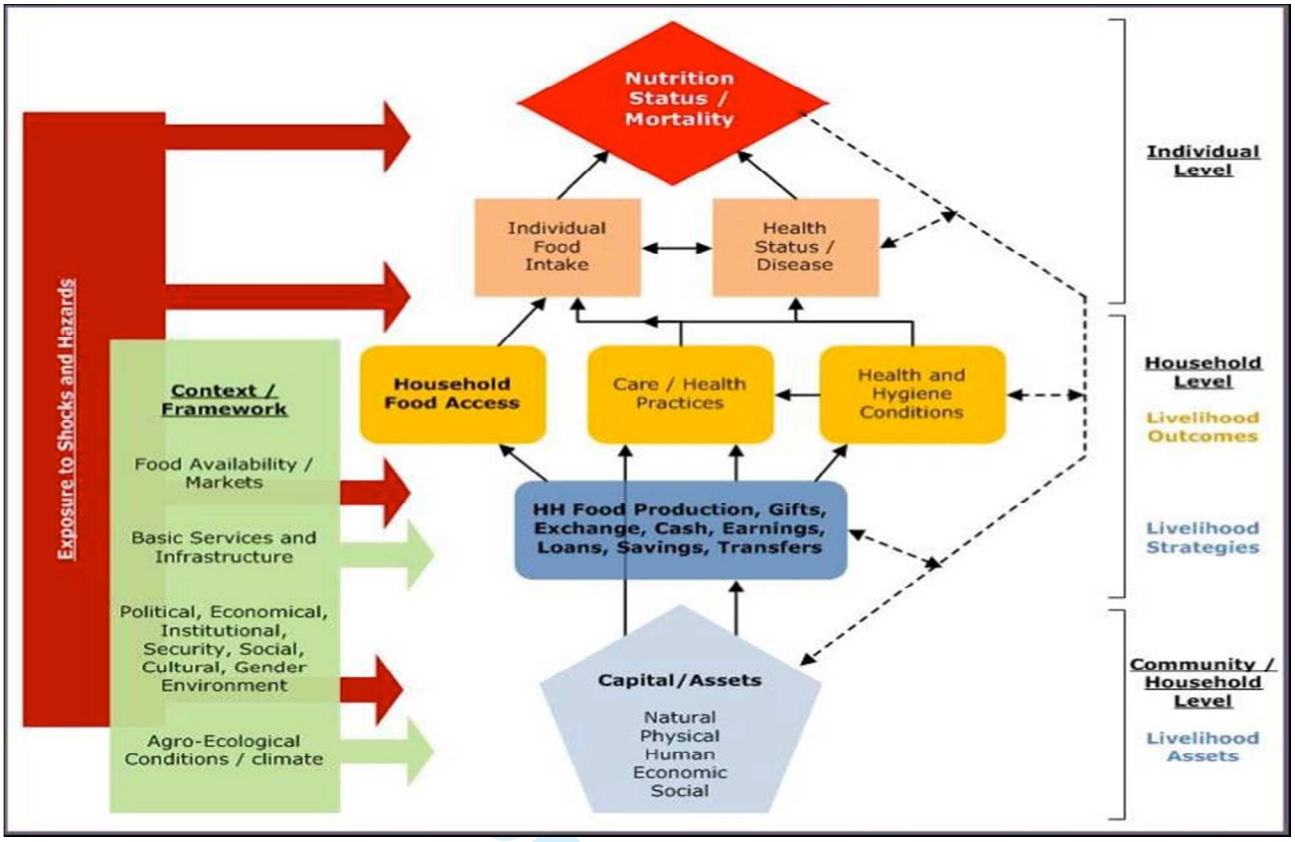

Figure 1: Food and Nutrition Security Conceptual Framework

Source: Adopted from WFP (2012).

Since food security is a multidimensional and complex issue, estimating food security has been a big challenge for researchers and practitioners. In general, analysts use proxy measures for different aspects of food security. For example, the coping strategies index, food expenditure index, dietary diversity measures are used to examine two or three pillars of food security (Barrett, 2010).[2]

Over the past 50 years, food access accounts for most food insecurity, which has focused on individual-specific hunger and underweight data.[3] This concept is based on poverty reduction,

[2] Three pillars of food security are availability, access, and use. For detail explanation including advantages and disadvantage of each method, please see Maxwell (1996); Barrett (2010).

[3] Hunger is defined as the physical discomfort or weakness caused by lack of food and can only be measured at the individual level.

food price, and social protection policies. Different data and methods may give different estimates. For example, individual or household data gives higher estimates of food insecurity than those obtained from aggregate level data. The reasons for the different estimates are intra, inter-households distribution of nutrient and nutritional availability. The estimates of food insecurity derived from survey data are highly correlated with poverty estimates (Barrett, 2010). Likewise, caloric adequacy has been used as a household measure of food access, but it is technically difficult, data intensive, and expensive to collect (Coates, Swindale, and Bilinsky, 2007).

USAID developed The Household Food Insecurity Access Scale (HFIAS) to estimate the prevalence of food insecurity in the U.S. annually. The HFIAS indicator is useful to measure food access because it is relatively simple, but methodologically rigorous (Coates *et al.,* 2007). The HFIAS indicator of the access factor of household food insecurity (henceforth household food insecurity (access) can be used to monitor and evaluate program intervention (Coates et al., 2007). The method is based on the assumption that experience of food insecurity (access) causes predictable reactions and responses that can be measured and quantified through a survey and summarized in scale.

This study follows the USAID Household Food Insecurity Access Scale (HFIAS) measure to examine the prevalence of food insecurity of farmers in northwestern Ghana. The HFIAS indicator includes many domains- behaviors and attributes that relate to various aspects of food insecurity. The USAID of Food and Nutrition Technical project suggest to follow the following steps to evaluate the impact of a program on food security:

3.1 Study Region and Data

To survey the farmers, this study adopted the Food and Nutrition Technical Assistance (FANTA) Project's questionnaire developed by USAID (Coates et al., 2007). Questions were divided into two categories: occurrence and frequency of occurrence questions and asked with a recall period of four weeks (30 days). If a respondent says "Yes" for the occurrence questions, then go to a frequency of occurrence. If a frequency of occurrence increases, it shows that the household is more food insecure. It means a household faces a problem of not having enough food for more than once in a month.

Data was obtained from 168 households in 10 communities from the northwestern region of Ghana. Households were categorized into participating (treatment) and non-participating households (control). The households were selected based on a prior random sample during a baseline study in 2010 and a mid-term study in 2012. The control households were sub-divided into households within the participating communities but are not actually treated and without households who are within 10 kilometers from the participating community. The study region and the status of food availability of the sample size is shown in figure 2 and figure 3, respectively. The summary statistics of the sample size households by gender and community is presented in Table 1.

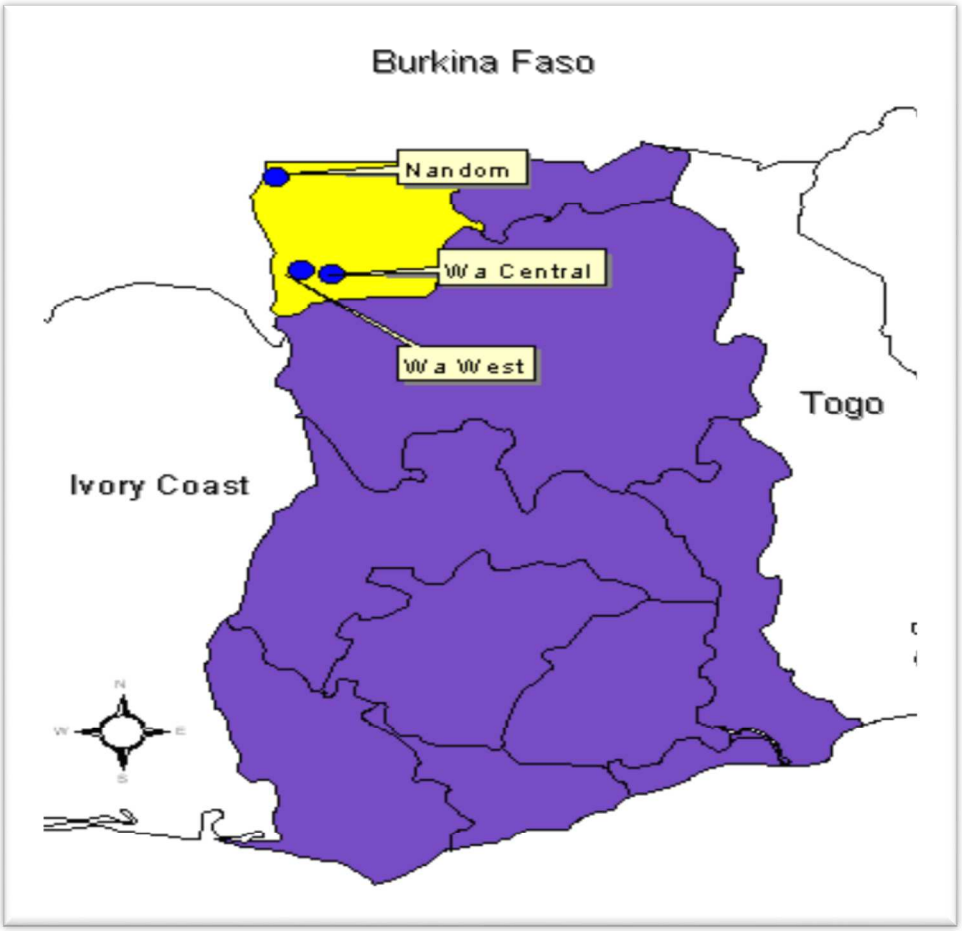

Figure 2. Study Region

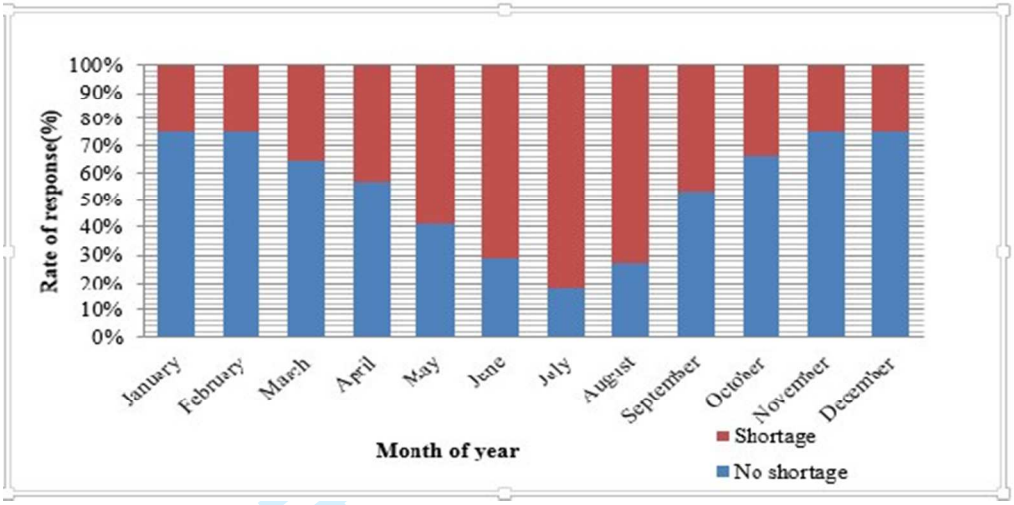

Figure 3. Household Food Availability Status in Northwestern Ghana

Table 1. Sample Households by Gender and Treatment

Category	*Name of Community*	*Male headed households*	*Female headed households*	*Total sample*
Participating (treated)	*Nyoli*	*17*	*7*	*24*
	Seiyiri	*18*	*1*	*19*
	Brutu	*13*	*1*	*14*
	Bu	*14*	*0*	*14*
	Puffien	*16*	*0*	*16*
	Busa-Tangzu	*21*	*2*	*23*
Non-participating (non-treated)	*Biihee*	*19*	*0*	*19*
	Nabugaun	*15*	*0*	*15*
	Kokoyiri	*11*	*0*	*11*
	Ga	*13*	*0*	*13*
	Total	*157*	*11*	*168*

4 Empirical Method and Results

To evaluate food insecurity from the perspective of food access for each household, occurrence and frequency of occurrence questions are adopted from the USAID's FANTA project (Coates et al., 2007). The nine occurrence questions (represent generally increasing level of severity of food insecurity (access) and the nine frequency of occurrence questions are used. The frequency

of occurrence questions works as follow up questions to each occurrence question. The FANTA project suggests to use the complete sets of questions to the examine food insecurity issues.

4.1 The Endogenous Treatment Effects Model (ETEM)

The endogenous treatment-effects model is a linear model that allows for correlation structure between unobservable affecting the household participation decisions and those affecting the household food insecurity access. The household food insecurity access (HFIAS) is a scale measure with 0 meaning food access and a maximum of 27 meaning food insecurity access. The idea is to model the treatment effect of household participation on sustainable agricultural intensification training program on food insecurity access scale. The endogenous treatment effects specification is used to assess the effectiveness of the household participation on food insecurity access scale measure (HFIAS) as in (Greene, 2002). The outcome model can be specified as follows:

$$HFIAS_i = X_i'\beta + \delta Part_i + \epsilon_i \qquad (1)$$

The effect of participation (binary) on $HFIAS_i$ is not captured by the δ, because this is the case of whether household i participates in the sustainable agriculture intensification training program or not (the case of self-selection). Hence, neglecting the potential endogeneity of participation produces wrong estimates of the treatment effect and also, overstate the effect of participation on household food insecurity access scale. Household participation decisions (treatment) is based on the household, individual and farm characteristics W_i, and it is modeled as:

$$Part_i^* = W_i'\Gamma + \mu_i \qquad (2)$$

$$Part_i = \begin{cases} 1 & if\ Part_i^* > 0 \\ 0 & Otherwise \end{cases}$$

Where X_i and W_i are covariates that are unrelated to the error terms. The assumption is that ϵ_i and μ_i are jointly normally distributed with mean zero and variance covariance matrix $\mathbf{\Sigma}$ given as:

$$\mathbf{\Sigma} = \begin{pmatrix} \sigma_1^2 & \rho\sigma_1 \\ \rho\sigma_1 & 1 \end{pmatrix}$$

The model above can be estimated using the two-step approach or the maximum likelihood approach. Therefore, this is simultaneously modelled as a participation decision model as in equation (2) and the outcome model as in equation (1). Consistent estimates of household participation decision on their food insecurity access is obtained by accounting for the endogenous participation.

4.2 Empirical Results

The maximum likelihood estimates of the model is presented in Table 2. The results of the Wald test justify the use the endogenous treatment-regression model as the test statistic of 10.89 is statistically significant at 0.001 level. This indicates the null hypothesis of the no correlation between the treatment and the outcome errors is rejected. The negative sign of the correlation coefficient indicates the unobservable that tend to increase household participation decisions in training program tend to lower their food insecurity access scale. The implication is that unobservable factors influencing household participation increases household food access. The treatment variable (participation) is positive and statistically significant. This represents the average treatment effect of the treated (ATET) and it is 2.95. Implying that participation in SAIPs training lower on average the household food insecurity access by about 2.95. This shows that household participating in SAIPs training programme are relatively likely to increase household food access.

Table 2. Maximum Likelihood Estimates of ETE Model

	Treatment		***Outcome***	
Variables	*Coef.*	*S.E*	*Coef.*	*S.E*
Constant			*12.825****	*2.669*
Gender	*-2.651****	*0.695*	*-1.559*	*2.772*
Age	*-0.015*	*0.014*	*-0.076**	*0.044*
Education	*0.027*	*0.096*	*0.195*	*0.309*
Experience	*-0.016*	*0.017*	*0.103***	*0.047*
Tenure	*2.488****	*0.680*	*-1.870*	*3.331*
Total acres	*-0.095****	*0.029*	*0.115****	*0.047*
Total time	*0.005**	*0.003*		

Organizational	*2.501****	*0.386*		
Credit	*0.403*	*0.334*		
Family labor (days)	*0.007*	*0.009*		
Income			*-0.001****	*0.001*
Occupation			*-1.086****	*0.263*
Participation			*-2.945***	*1.314*
$\boldsymbol{\rho}$			*-0.709****	*0.133*
$\boldsymbol{\sigma}$			*5.292****	*0.308*
$\boldsymbol{\lambda}$			*-3.754****	*0.801*
$\boldsymbol{\chi_9^2}$			*109.27****	
Wald test $(\boldsymbol{\rho = 0})$			*10.89****	
Log likelihood			*-604.531*	

*Where ***, **, & * represents 0.01, 0.05 & 0.10 p-levels respectively*

4.3 Factors Influencing Household Training Participation

Factors affecting household participation in the SAIPs training program include gender, land ownership, total land etc. The coefficient of gender variable has negative sign and significant. It implies that female headed households are more likely to participate in the training program than male headed households. The expected positive and significant effect of land ownership (tenure) in the treatment model indicates that household who owns their plots are more likely to participate in the training program. This makes sense since the SAIPs program is a long-term investment and non-plot owners are not interested to invest in something that might be short-term because they may easily lose the plot of land at any time. The expected negative and significant effect of total land allocated to production on training show that households with smaller land size are more likely to take part in the training program than those with bigger plot sizes.

Distance to plot has positive and significant effect on training. The implication is that household with distant plots are more likely to participate in the training program than those with plots nearer their households. Farmer organizational affiliation has positive and significant

effect on participation. The implication is that household with farmer organizational ties are more likely to take part in the training program compared with those who have no ties. This might be due to peer learning and the fact that it allows for innovations and reduces individual conservativeness. Education, credit and family labor days have the expected positive sign, but they are not insignificant.

4.4 Factors Influencing Household Food Insecurity Access Scale (HFIAS=Outcome)

The results show that age has a negative and significant effect on household food insecurity access scale. The implication is that younger households' heads are likely to have more food access compared to their older counterparts. This result confirms the findings that younger households' heads will participate in SAIPs training compared to older ones. The younger households are more interested in learning and hence are more likely to adopt innovations. The results indicate that experience has positive and significant impact on household food insecurity access scale. The implication is that farmers who have experience in farming have more food access than less experience ones. This can loosely be related to being in the system for some time and by default are older which is corroborated by the finding of the age variable.

Total acres allocated to agricultural production has positive and significant effect on food insecurity access scale. It implies that households with large acreage in agricultural production have high food insecurity access compared to small-holders. This can be attributed to the fact that small-holder households were more involved in the training program and it confirms the impact of the training on households. Household total income has negative and significant effect on household food (insecurity) access scale. The food (insecurity) access increases with increasing income. This is unexpected but can be attributed to the fact that the SAIPs training targeted small-holder resource-poor households. The negative and significant effect of occupation implies that households whose occupation is mainly crop production are likely have more food access. The implication is that food producers who took part in the training program will have access to food compared to non-food crop producers.

The most important variable in this study is participation. When farmers participate in the SAIPs program, the predicted value of HFIAS score is 2.95 points lower than the non-participating farmers, holding other things constant. The significant reduction of the HFIAS

score shows that the participating households are likely to have higher food access than the non-participating farmers.

5. Conclusion

Sustainable agricultural intensification practices trainings are in a research phase in north western Ghana. Past research has shown that agricultural intensification trainings and communications among farmers are the effective tools to increase agricultural and crop management practices, which help to increase yields. This research investigated the impact of the SAIPs trainings on household food security in north western Ghana using the household food insecurity access scale indicator. We also examined the factors that affect household food security using the endogenous treatment model, which also evaluates the impact of a project on the outcome variable. The results of the endogenous treatment model indicate the HFIAS score decreased by 2.95 points, which is approximately an 11% reduction in HFIAS score. The reduction in the HFIAS score indicates that the participating households are more likely to have higher food access than the non-participating farmers. In other words, the training programme helps to increase food security (access) in North Western Ghana. However, we may not generalize the results beyond the study area to other rural communities due to the unique conditions prevailing in North Western Ghana. Instead, SAIPs trainings can be replicated in other rural settings susceptible to household food insecurity, to be followed by respective impact study. Future research in the direction of SAIPs trainings and impact study replications in all qualifying rural areas in Ghana for example will provide a national picture of the efficacy of SAIPs trainings on household food insecurity.

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