IMPACT OF CROP PRODUCTIVITY ON POVERTY AMONG FARM HOUSEHOLDS IN GHANA

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ABSTRACT

Ghana Poverty Reduction Strategy I & II sought to increase crop productivity to reduce high poverty incidence in farm sector, but the magnitude of impact of the productivity on poverty is not present in all agro-ecological zones in Ghana. The aim of the study is to estimate poverty headcount ratio, poverty gap and poverty severity, and link crop productivity to poverty according to agroecology subject to a two-step instrumental variable regression technique using Pseudo Panel data from the Ghana Living Standards Survey (GLSS rounds 5 & 6). Farmers' poverty headcount ratio, poverty gap, and poverty severity reduced from 57%, 25%, and 14% in 2005 to 37%, 14%, and 7% in 2013 respectively. The result further indicates that 1% growth in crop productivity reduces the probability of poverty headcount ratio, poverty gap and poverty severity by 0.28%, 0.38% and 0.75% respectively in all agro-ecological zones. Additionally, the paper shows that education, livestock and remittance income reduces poverty, while household size and great distance to access water increase poverty differently from agro-ecology. The study recommends rapid crop productivity growth by prioritizing technology adoption and institutional coordination to suit agro-ecological conditions among the poor, illiterate and non-partisan.

1. INTRODUCTION

Agricultural sector is the smallest among the sectors of the economy consisting of crops, cocoa, livestock, fishing, forestry and logging with a contribution to the economy of about 26%. It provided basic food, employment, and foreign exchange for economic growth and poverty reduction in Ghana between 2006 and 2017 (GSS, 2017). Ghana's agriculture is predominantly smallholder and rain-fed and about 60% of all farms in the country are less than 1.2 hectares in size and farming systems vary across agro-ecological zones of different cropping systems, the forest zone, where tree crops like cocoa, oil palm, coffee and rubber flourish. The food crops in this area include maize, plantain, cocoyam and cassava. Maize, millet, cowpeas, groundnuts, yam and rice are some of the main crops that are cultivated in the northern parts of Ghana of the savannah agro-ecological zone (ITA, 2020). Crop productivity is defined as the output per unit of input where maize, rice, cashew, and cocoa productivity are 1.92Mt/Ha, 2.75Mt/Ha, 0.50Mt/Ha, 0.50Mt/Ha against achievable yields of 5.5 Mt/Ha, 6Mt/Ha, 1.8Mt/Ha, 1Mt/Ha respectively (MoFA, 2015). In 2018, yields of targeted crops continued to record significant improvements over 2016 levels: maize yield increased by 89% from 1.8mt/ha to 3.4mt/ha; rice yield increased by 48% from 2.7mt/ha to 4.0mt/ha and soya yield increased by 200% from 1mt/ha to 3.0mt/ha (MTEF, 2020).

Over the years the government have rolled out programmes to boost productivity levels of agriculture to reduce poverty. These include Accelerated Agricultural Growth and Development Strategy (AAGDS), Food and Agriculture Sector Development Policy I & II (2002-2009), Medium-Term Agricultural Sector Investment Plan (2011-2015), etc. The poor who are employed in agriculture sub-sector need output growth by at least 6% to reduce poverty. Agricultural output has increased with improved weather variables, conventional inputs, rural infrastructure, institutional factors and poverty reduction policies (Thirtle et al., 2003). Barriers to the use of technology and market access should be overcome to improve productivity for poverty reduction (Schneider & Gugerty, 2011). In the 1990s projects which enhanced productivity growth were the Ghana Grains Development Project (GGDP) (Morris et al., 1998) and National Cocoa Diseases and Pest Control (CODAPEC) programme, to combat the Capsid/Mirid and the Black Pod disease on cocoa farms.

Poverty in economic terms is mainly defined as earning less than an estimated income to provide for basic needs such as food, clothing, and housing (GSS, 2018) and being deprived of education, health and living standards. Since 1990, income poverty has fallen in all regions of the world except SSA, where there

has been an increase both in the incidence and absolute number of people living in poverty of about 300 million people in SSA – almost half of the region's population – living on less than US$1 a day (Handley et al., 2009). In self-employed households in non-agricultural sub-sector the poverty rate decreased from 17% in 2005 to 8.9% in 2017. Crop farmers' poverty rate decreased from 45.1% in 2005 to 39.2% in 2013 but increased to 42.7% in 2017 in Ghana (GSS, 2014; GSS, 2018). With these reductions, Ghana surpassed the first Millennium Development Goal (MDG) of halving poverty by 2015 as opposed to crop farmers (GSS, 2014). Poverty reduction strategies include the Ghana Vision (2020), Ghana Poverty Reduction Strategy (2003-2005), the Growth and Poverty Reduction Strategy (2006-2009) and Ghana Shared Growth and Development Agenda (GSGDA 2010-2013).

Agricultural productivity increases to reduce poverty through income, lower food prices, increase in wages and rural multiplier effects (Bresciani & Valdes 2007; Christiansen et al., 2013). NGOs contribute to improving income, productivity and the use of basic social benefits to reduce poverty in northern Ghana (Adjei et al., 2012). Improved Chickpea pea varieties increased household income to reduce poverty in Ethiopia (Verkaart et al., 2017). Technology adoption increased crop output to reduce poverty by 5% in Kenya (Oehmke et al., 2010). Agricultural productivity increased farm output to reduce urban food prices, which increased consumption especially for the poor in Ghana and found that agricultural sector growth contributed to Ghana's non-agricultural sector growth with multiplier effects, but studies on the impact of crop productivity on poverty are limited in Ghana (Alhassan & Jatoe, 2007). Among few studies measuring the quantitative impacts of crop production on poverty reduction found that crop sales increased household expenditure and had positive and statistically significant impacts on poverty reduction for crop-growing households and the rural population in Vietnam (Cuong, 2009). The study found that an increase of 1 Viet Nam dong (VND) in rice revenues leads to an increase of 0.019 VND in per capita expenditure, and the corresponding figures for revenues from annual crops, perennial crops and fruits are 0.038, 0.040 and 0.036, respectively. Panda (2007) showed that 1% growth in agricultural income per capita reduced poverty headcount ratio by 0.22% in India and Dzanku (2015) showed that crop productivity reduced poverty by 0.14%, which failed to account for agro-ecological conditions in Ghana. In the coastal, forest and savannah agro-ecological zones have different farming systems on food and tree crops, with varying potential for agricultural growth, demographic and economic importance and potential for poverty reduction (Hall et al., 2001). The agro-ecologies are diverse in terms of farming systems, cereal-based, perennial-crop-based, and livestock based pas-

toral areas in Ethiopia. The results show that high poverty incidence and adoption of agricultural technologies, i.e. improved seeds with appropriate agronomic packages, would increase yields and incomes substantially, and reduce poverty in Ethiopia (Kotu & Admassie, 2016). Crop productivity provides food and income to reduce poverty among farm households in Ghana but few studies have revealed the magnitude of this relationship and presented the analysis in the agro-ecological zones of Ghana. Thus, the paper seeks to estimate crop farmers' poverty rate and examine the magnitude of the impact of crop productivity on poverty among farm households in Ghana (2005/06 and 2012/13).

2. MATERIALS AND METHODS

2.1. Conceptual framework

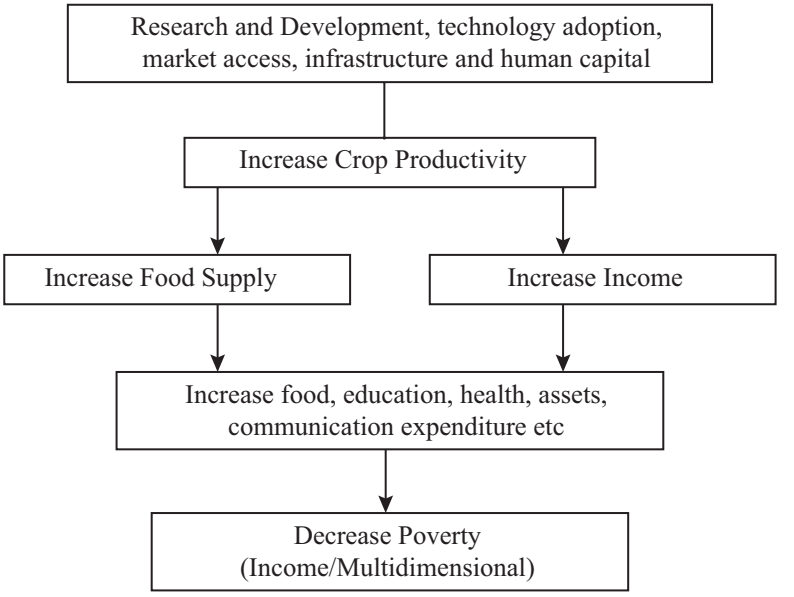

Figure 1. Conceptual framework: pathways to poverty
Adapted from Christiansen & Kuhl (2011)

Productivity enhancing factors such as infrastructure, human capital, research and development, and improved technology increase crop yields. The increased yield generates higher income to increase expenditures on food, education, health, water, electricity, clothing, transportation among others to decrease poverty as shown in Figure 1.

2.2. Materials and methods

We define y as farm and non-farm income in equation (1). Also, $fA(l,t,E)$ represents production function, l represents farm size, t is total labour supply, t_s is farm labour supply, t_n is non-farm labour supply, and w is wage rate for unskilled labour, p_j is price of output and E is agro-ecological conditions. A is productivity of the underlying technology.

$$y = y\left[p_j Af(l,t_s,E) + w(t_n) \mid E \right] \tag{1}$$

Income y is totally differentiated, dy below

$$dy = \frac{\partial y}{\partial p_j} dp_j * f(Q) + \frac{\partial y}{\partial Q} dQ * P_j + \frac{\partial y}{dw} dw * t_n + \frac{\partial y}{\partial t_n} dt_n * W \tag{2}$$

Equation (2) is expanded by $dp_j = \frac{\partial p_j}{\partial A} dA,\ dQ_j = \frac{\partial Q_j}{\partial A} dA,\ dw = \frac{\partial w}{\partial A} dA,\ dt_n = \frac{\partial t_n}{\partial A} dA$ due to productivity growth (dA) and simplified to get equation (3).

$$\frac{dy}{dA} = \frac{p_j * Q_j}{A} (\varepsilon_{Qj}, A + -\varepsilon_{pj}, A) + \frac{w * t_n}{A} (\varepsilon_w + \varepsilon_{tn}) \tag{3}$$

If output elasticity is greater than negative price elasticity at a given crop productivity growth, income increases for consumption of goods and services to reduce poverty (Minten & Barrett, 2008).

2.3. Estimation of poverty rate

The Foster-Greer-Thorbecke (1984) poverty indexes are shown below:

$$P_0 = \frac{q}{n} \rightarrow \text{ Poverty headcount ratio} \tag{4}$$

$$P_1 = \frac{1}{n} \sum_{i=1}^{q} \left[(z - y)/z \right]^1 \rightarrow \text{ Poverty gap} \tag{5}$$

$$P_2 = \frac{1}{n} \sum_{i=1}^{q} \left[(z - y)/z \right]^2 \rightarrow \text{ Poverty severity} \tag{6}$$

n = Number of households in a group, q *is* the number of poor households per group z *is* poverty Line, y *is* household expenditure per capita adult equivalent of i-th household in the specified group.

2.4. Crop productivity and poverty reduction

The impact of crop productivity on poverty is estimated using two stage instrumental variable panel fixed and random effects regression model in line with Dzanku (2015) as shown in equations (7) & (8). The model has been controlled for endogeneity of the error terms because of possible correlation of crop productivity and other explanatory variables. The double log model normalizes the standard errors and the error term ε_{it} is assumed to be independent and identically distributed from a normal distribution which is estimated with STATA.

Stage 1:

$$lcp = \alpha_0 + \alpha_1 \log k_{1it} + \alpha_2 \log k_{2it} \tag{7}$$

Stage 2:

$$\left(\frac{P_{0it}}{1-P_{0it}}\right) = \beta_0 + \sum_{j=1}^{7} \beta_j \log x_{jit} + \varepsilon_{it} \tag{8}$$

$$lP_1 = \beta_1 + \sum_{j=1}^{7} \beta_j \log x_{jit} + \varepsilon_{it} \tag{9}$$

$$lP_2 = \beta_1 + \sum_{j=1}^{7} \beta_j \log x_{jit} + \varepsilon_{it} \tag{10}$$

2.5. Description of variables with the expected impact on poverty

The dependent variables are poverty headcount ratio P_0, poverty gap P_1 and severity P_2. The independent variables are $x_1 - x_7$ which are assumed to be exogenous and influence poverty. x_1, is the logarithm of crop productivity measured as crop income per hectare of land to provide food and income for consumption to reduce poverty is instrumented by the cost of seed and labour inputs (k_1) and the cost of intermediate inputs (k_2). Relevant studies by Irz et al. (2001) and De Janvry and Sadoulet (2009) confirm that agricultural productivity provides income to reduce poverty significantly. x_2, is the logarithm of household size which is a

measure of the number of household members and it is associated with consumption negatively in increasing poverty (Iheke & Nwaru, 2013; Coppola & Laurea, 2016). x_3, is the logarithm of years of education which improves decision making skills of farmers to increase productivity to influence poverty (Anyanwu, 2005). x_4, is the logarithm of distance to water source in kilometres which is expected to increase poverty by delaying economic activities, x_5, is the logarithm of days of inactivity due to ill health, which is expected to reduce consumption to positively affect poverty (Grant, 2009). x_6, is the logarithm of the amount of remittances received by the farmer to provide additional household income to reduce poverty. x_7, is the logarithm of livestock income to positively increase household consumption especially during the lean season and crop failure.

2.6. Data and a sampling technique

The study employed Ghana Living Standards Survey in 2005/06 and 2012/13 when major agricultural policies were implemented and no current data was available. The data was collected from ten regions of Ghana by purposive and random sampling techniques to include 2910 and 8355 farm households respectively. Due to challenges with panel data, this study used repeated independent cross-sectional data which forms a Pseudo Panel data by age, sex, and agro-ecology. Finally, the cohort size is the result of a trade-off between bias and the cohort variance means that consistent and efficient estimates are generated (Guillerm, 2017).

3. RESULTS

3.1 Summary of statistics

Crop productivity (income/ha) provides food and income for poor and non-poor farmers to increase household consumption expenditure to reduce poverty. Musah et al. (2016) found that engagement in the farm sector provided income to increase consumption expenditures in three northern regions of Ghana. The study further finds that crop productivity (kg/ha) increases by 13% for poor farmers from the use of chemical, seed and labour inputs but reduced by 8.3% for non-poor farmers. Poor households are middle age, with a basic level of education as they have little capital and moderate access to additional livestock and remittance income to reduce poverty. Poor households have larger household size for increasing food and non-food demand in order to increase poverty (Table 1).

Table 1. Summary of statistics by poverty status

Variable description	Mean		Mean difference	Mean		Mean difference
	Poor	Non-poor		Poor	Non-poor	
	2005	2005		2013	2013	
Crop productivity ₵/ha	177.93	283.76	105.82***	682.97	894.46	211.49***
Crop productivity kg/ha	636.30	954.30	318.00**	720.27	874.92	154.65***
Consumption per adult ₵	727.50	2502.36	1774.85**	832.15	3083.84	2251.69***
Chemical cost ₵	20.94	54.66	33.71***	172.00	259.59	87.59***
Seed & labour cost ₵	27.43	82.98	55.55***	73.20	164.68	91.47***
Household head age	47.54	47.11	-.43	49.26	47.94	-1.32***
Household size number	6.06	3.68	-2.38***	6.44	4.40	-2.04***
Years of education	7.61	8.69	1.07***	6.97	8.56	1.58***
Remittance income ₵	28.68	59.69	31.00***	87.35	214.96	127.61***
Livestock income ₵	48.35	29.78	-16.24**	23.39	95.98	72.58*

Source: author's estimated output, 2018 *** ** * 1%, 5%, & 10% significant levels

3.2. Source of income

The pattern of income sources shows that agriculture is the major income source for farmers and that wage and income sources for non-farmers are significant.

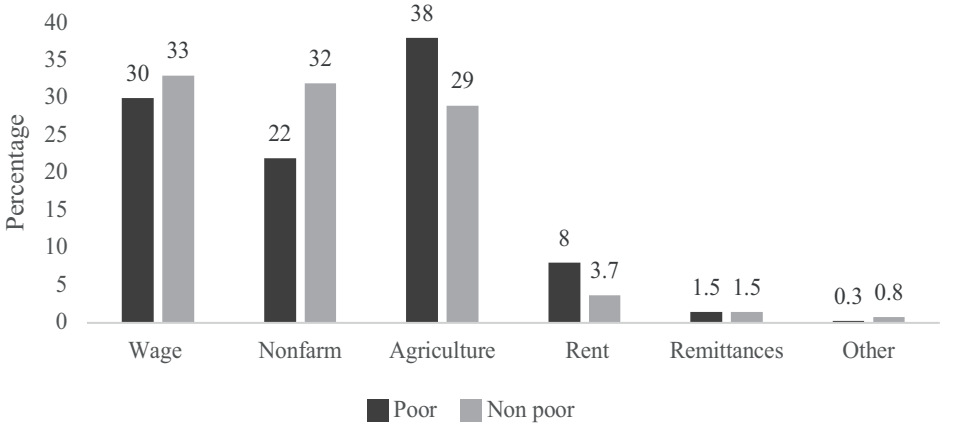

Figure 2. Sources of income from GLSS 6 Survey Data

3.3. Crop productivity

Maize, rice, beans, cashew and cotton output increased, but sorghum, cocoa, and coconut output decreased from 2005 to 2013. Farm size has been reduced for

beans but significantly increased for cashew. Maize, beans, cocoa and cashew yields increased, but rice, sorghum, and groundnut yields decreased. The study reveals low maize productivity of 0.95mt/ha compared to optimum maize yield 5.5mt/ha. Cocoa yield is 0.47mt/ha relative to optimum yield of 1mt/ha (Table 2).

Table 2. Crop productivity

Crop Type	Output (kg)		Farm size(ha)		Output kg /ha		Revenue ₵/ ha	
	2005	2013	2005	2013	2005	2013	2005	2013
Maize	572.58	952.14	1.16	1.17	867.23	951.93	275.64	796.98
Rice	372.71	572.18	1.04	.91	765.70	693.29	210.87	675.23
Sorghum	393.75	314.32	1.12	.93	506.01	461.10	126.18	413.43
Millet	263.47	315.88	1.14	.95	407.37	446.81	114.95	449.26
Groundnut	458.88	535.34	1.02	1.07	714.38	692.17	293.99	835.25
Beans	142.63	294.72	1.03	.85	336.82	504.90	121.07	536.70
Cocoa	895.94	757.76	2.76	2.55	306.22	472.77	315.02	1652.88
Cashew	128.87	789.00	1.34	2.31	128.85	572.41	71.37	873.66
Coconut	569.14	494.36	2.90	1.03	164.15	660.31	80.65	569.09
Cotton	630.43	1222.3	1.69	1.10	1326.0	1256.71	547.14	902.63
All Crops	1284.0	1603.6	3.32	3.35	763.81	811.59	257.24	806.82

Source: Authors' estimation, 2018 GLSS 5 & 6

3.4. Food and non-food expenditure

The study finds that average consumption ₵831.47 is below the poverty line ₵1314 among poor farmers and non-poor farmers whose average consumption ₵3091 is higher than the poverty line. The proportion of food expenditure increases significantly for poor farmers but the rich spend more on food than the poor in absolute terms, the latter allocate high proportions of their income to food consumption (Donkoh et al., 2014). Non-food expenditure constitutes health, education, transportation, remittances, clothing, etc. In a related study, the breakdown of costs indicated that 52% of the costs of living are for food, 13% are for housing, 30% are for other essential needs, and 5% are for sustainability (Sally & Sarpong, 2018). The Ghana Statistical Service requires GH₵792 for minimum food expenditure for 2900 calories intake and GH₵522 minimum non-food expenditure (Table 3).

Table 3. Food and non-food consumption expenditure per adult equivalent

2005/06	Mean		2005/06	Mean		2012/13
Expenditure	Poor	Non-poor	Difference	Poor	Non-poor	Difference
Food	397.78	1339.93	942.14***	516.96	1767.51	1250.54***
Non-food	275.13	972.84	697.71***	314.52	1323.80	1009.29***
Total	727.77	2497.60	1769.81***	831.47	3091.31	2259.83***

Source: Authors' estimated output, 2018

3.5. Poverty levels

The study found that farmers' consumption increased from ₵1486.16 to ₵2244.07 to reduce poverty headcount ratio from 57% in 2005 to 37% in 2013. Farmer's poverty rate has been reduced by 20 % with 9% less to achieve the MDG target of halving poverty by 2013. Crop producer's poverty rates decreased from 35%, 36%, and 76% in 2005 to 21%, 22%, and 51% in the coastal, forest and savannah zones respectively in 2013, while the poverty rates are higher in the savannah zone. The study found that crop producers' poverty gap decreased from 25% in 2005 to 14% in 2013 and poverty severity dropped from 14% in 2005 to 6.8% in 2013 (Table 4). Biam & Tavershima (2020) study showed that 49.7% of the rural farming households required 2100 kilocalories per capita per day to be classified as food secure while most of the rural farming households (50.3%) were unable to meet the recommended calorie intake of 2100 kilocalorie per capita per day in Nigeria. In a related study about 47.6% of households live below the poverty line (Birr 389) with a poverty gap index of 17.8% and a poverty severity index of 9.2% among pastoralist in Ethiopia (Teka et al., 2019).

Table 4. Poverty levels by agro-ecology

Crop categories	P_1		P_2		P_3		Consumption		Population	
All crops	2005	2013	2005	2013	2005	2013	2005	2013	2005	2013
Coastal zone	35	21	9.6	5.6	3.8	2	2121.18	3062.75	268	482
Forest zone	36	22	10	6.0	4	2.3	1975.51	2707.42	1,124	3,382
Savannah zone	76	51	39	20	24	11	1025.96	1806.97	1,565	4,488
National	57	37	25	14	14	6.8	1486.16	2244.07	2,957	8,352

Source: Authors' estimated output, 2018

3.6. Impact of crop productivity on poverty

The study results reveal that growth in crop productivity by 1% reduces poverty headcount ratio by 0.28% and by 0.23%, 0.29% and 0.29%, in the coastal, forest and savannah zones respectively similar to the national estimate. The study finds

that growth in crop productivity by 1% reduces poverty gap by 0.38% and by 0.27%, 0.39%, and 0.38% in the coastal, forest and savannah zones respectively. The study further finds that growth in crop productivity by 1% reduces poverty severity by 0.75% and by 0.55%, 0.78% and 0.75% in the coastal, forest and savannah zones (Table 5). Crop productivity provides food and income to increase household consumption on food and non-food items such as clothing, transportation, health, remittances, etc. to reduce the incidence and extent of poverty. The estimates of this study are larger than Dzanku's study (2015) which found that growth in crop productivity by 1% reduced probability of poverty headcount ratio by 0.14% in Ghana without accounting for agro-ecological conditions. But the estimates of this study are comparable to Panda's study (2007) which found that agricultural income per capita reduced poverty headcount ratio, poverty gap, and poverty severity by 0.22%, 0.39%, and 0.53% respectively in India.

The paper finds that increase in household size by 1% increases the probability of poverty headcount ratio, by 1.35% and by 1.78%, 1.48%, and 1.28% in the coastal, forest, and savannah zones respectively. The study reveals that increase in household size by 1% increases poverty gap by 0.33%, and by 0.63%, 0.29%, and 0.62% in the coastal, forest and savannah agro-ecological zones respectively. The study further reveals that increase in household size by 1% increases poverty severity by 0.66% and by 0.63%, 0.29%, and 0.62% in the coastal, forest and savannah zones respectively (Coppola & Laurea 2016). Molini & Paci (2015) found that larger households have 4% higher probability of being poor in Ghana. The findings of the study reveal that household size decreases food security by increasing household food requirements in Benue State, Nigeria (Biam & Tavershima 2020). The study further reveals that increase in years of education by 1% reduces probability of poverty headcount ratio, by 0.37% and by 0.37% and 0.41% significantly in the forest and savannah zones. The study finds that increase in years of education by 1% reduces poverty gap and poverty severity by 0.12% and 0.24% respectively in the savannah zone only by improving skills in literacy, and numeracy for proper decision making to increase household income and consumption in order to reduce poverty (Sen, 2014; Anyanwu, 2005). In Nigeria, the study found that educated heads of the household have 6% likelihood to be food secure because an educated head of the household is more sensitive to adopting technology to maximize farm and non-farm output, which contributes directly to household food security (Biam & Tavershima 2020). The determinants of poverty headcount ratio, poverty gap and severity were estimated by the random effects model as consistent and effective using the Hausman specification test.

Table 5. Crop productivity and poverty

Variables	Poverty headcount	Poverty gap	Poverty severity
Output value ha	-0.282***	-0.376***	-0.751***
	(0.0206)	(0.0375)	(0.0750)
Household size	1.353***	0.331***	0.663***
	(0.0430)	(0.0291)	(0.0581)
Years of education	-0.372***	-0.094***	-0.187***
	(0.0233)	(0.0163)	(0.0326)
Sick days	-0.105***	-0.071***	-0.143***
	(0.0389)	(0.0254)	(0.0508)
Distance from water source	0.0790***	0.0130	0.0259
	(0.0125)	(0.00870)	(0.0174)
Livestock sales	-0.148***	0.0135*	0.0270*
	(0.0102)	(0.00810)	(0.0162)
Remittance	-0.0384***	-0.017***	-0.035***
	(0.00953)	(0.00652)	(0.0130)
Forest zone	0.0868	0.137	0.273
	(0.110)	(0.0860)	(0.172)
Savannah zone	0.891***	0.436***	0.871***
	(0.111)	(0.0828)	(0.166)
Constant	-1.124***	-0.0205	-0.0410
	(0.172)	(0.221)	(0.443)

Source: Author's estimated output 2018 *** p<0.01, ** p<0.05, * p<0.1

The result of the study finds that increase in inactivity days due to ill health by 1% is negatively related to poverty headcount ratio, poverty gap, and poverty severity by 0.15%, 0.13%, and 0.26% respectively in the savannah zone only. Somi et al. (2009) reveal that households affected by Malaria reduced their consumption of drugs and food. The findings of the study show that increase in distance to water intake by 1% increases probability of poverty headcount ratio by 0.08% and by 0.07% and 0.09% in the forest and savannah zones due to the loss of productive water demand labour to negatively affect income and consumption. The study further shows that increase in livestock income by 1% reduces probability of poverty headcount ratio by 0.15% and by 0.09%, 0.13% and 0.16% in the coastal, forest and savannah zones respectively, while increase in livestock income by 1% increases poverty gap and severity by 0.014% and 0.03% and very poor farmers raise livestock, which is not effective in reducing poverty. Maltsoghou & Rapsomanikies (2005) found that income from pigs and chickens

reduces poverty, but an increase in the share of livestock income in total farm income is positively associated with the poverty incidence in Vietnam.

The study found that increase in remittance income by 1% reduces poverty headcount ratio by 0.04% and by 0.06% and 0.03% in the forest and savannah zone. The study finds that increase in remittance income reduces poverty gap by 0.02% and by 0.03% and 0.13% in the forest and savannah zone. The study found that increase in remittance income by 1% reduces poverty severity by 0.03% and by 0.06% and 0.03% respectively in the forest and savannah zones due to additional household income. Internal and external remittances reduce spending on food at the margin but increase spending on investment goods such as education, housing and health in order to reduce poverty in Ghana (Adams & Cuecuecha, 2013). The results of the study further show that agro-ecological condition in the savannah is positively related to the poverty headcount ratio, poverty gap and severity by 0.89%, 0.44%, and 0.87% respectively. The study found that poverty rates were higher among farmers especially in the savannah zone, and that in the Guinea savannah zone increases probability of poverty incidence by 0.29% but reduces it in the forest zone by 0.17% in Nigeria (Omobowale 2014).

Table 6. Impact of crop productivity on poverty by agro-ecology

Variables	Poverty headcount ratio			Poverty gap			Poverty severity		
	Coastal	Forest	Savannah	Coastal	Forest	Savannah	Coastal	Forest	Savannah
Output value ha	-0.23***	-0.29***	-0.29***	-0.27**	-0.39***	-0.38***	-0.55**	-0.78***	-0.75***
	(0.068)	(0.03)	(0.30)	(0.11)	(0.10)	(0.04)	(0.22)	(0.20)	(0.08)
Household size	1.74***	1.48***	1.28***	0.31*	0.40***	0.31***	0.63*	0.79***	0.62***
	(0.21)	(0.08)	(0.06)	(0.17)	(0.07)	(0.03)	(0.33)	(0.15)	(0.06)
Years of education	-0.03	-0.37***	-0.41***	-0.02	-0.05	-0.12***	-0.04	-0.09	-0.24***
	(0.10)	(0.04)	(0.03)	(0.08)	(0.03)	(0.02)	(0.17)	(0.07)	(0.04)
Sick days	-0.017	-0.087	-0.15***	0.06	0.02	-0.13***	0.12	0.04	-0.26***
	(0.15)	(0.06)	(0.05)	(0.11)	(0.05)	(0.03)	(0.23)	(0.10)	(0.06)
Distance from water	0.065	0.069***	0.09***	0.02	0.02	0.01	0.04	0.04	0.02
	(0.042)	(0.021)	(0.02)	(0.03)	(0.02)	(0.01)	(0.07)	(0.04)	(0.02)
Livestock sales	-0.09**	-0.13***	-0.16***	0.02	0.03	0.01	0.03	0.06	0.02
	(0.04)	(0.02)	(0.0128)	(0.04)	(0.02)	(0.01)	(0.08)	(0.04)	(0.02)
Remittance	0.03	-0.06***	-0.029**	-0.03	-0.03**	-0.01*	-0.06	-0.06**	-0.0250*
	(0.04)	(0.02)	(0.01)	(0.03)	(0.01)	(0.01)	(0.06)	(0.03)	(0.01)
Constant				-0.56	0.01	0.48**	-1.12	0.03	0.96**
				(0.637)	(0.557)	(0.236)	(1.28)	(1.11)	(0.47)

Source: Author's estimated output 2018 *** p<0.01, ** p<0.05, * p<0.1

4. CONCLUSIONS

The study estimated the impact of crop productivity on poverty to reveal that crop income per hectare of land increases consumption of food and non-food items leading to poverty reduction. The poverty rates are moderate in the costal and forest zones but higher in the savannah zone, and crop productivity reduces poverty moderately, and the results show that crop productivity reduces poverty significantly in the coastal, forest and savannah zones similar to the national estimate. The study further reveals that education, livestock and remittance income complements farmers' efforts to reduce poverty, but household size and distance to water increase farmers' poverty in Ghana's agro-ecological zones. The study recommends rapid crop productivity growth by prioritizing technology adoption and institutional coordination suitable to coastal, forest, and savannah agro-ecological conditions among the poor, illiterate and non-partisan to increase crop yields and revenue in order to reduce poverty effectively. Farmers' access to education, family planning, remittance and livestock income needs to be improved to help reduce poverty in the relevant agro-ecological zones in Ghana.

Conflict of interests

The authors declare there is no conflict of interest.

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УТИЦАЈ ПРОДУКТИВНОСТИ УСЈЕВА НА СИРОМАШТВО ФАРМЕРСКИХ ДОМАЋИНСТАВА У ГАНИ

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САЖЕТАК

Стратегије за смањење сиромаштва у Гани I и II су настојале да повећају продуктивност усјева како би се смањило велико сиромаштво у пољопривредном сектору, али ефекат продуктивности на сиромаштво изостаје у свим агроеколошким зонама Гане. Циљеви студије су да се процијени однос сиромаштва по глави становника, јаза сиромаштва и озбиљности сиромаштва, те да се повеже продуктивност усјева са сиромаштвом агроеколошког субјекта у двостепеној регресионој техници инструменталних варијабли помоћу података из псеудо-панела из Анкете о животном стандарду у Гани (ГЛСС серија 5 и 6). Однос сиромаштва по глави становника међу фармерима, јаза сиромаштва и озбиљност сиромаштва смањени су са 57%, 25% и 14% у 2005. години, на 37%, 14% и 7% у 2013. години. Резултати даље указује да раст продуктивности усјева од 1% смањује вјероватноћу односа сиромаштва по глави становника, јаза сиромаштва и озбиљности сиромаштва за 0,28%, 0,38% и 0,75% у свим агроеколошким зонама. Поред тога, рад показује да образовање, стока и приход од дознака смањују сиромаштво, док величина домаћинства и велика удаљеност до извора воде повећавају сиромаштво на различите начине у зависности од агроекологије. Студија препоручује брз раст продуктивности усјева давањем приорите-

та усвајању технологије и институционалне координације које би одговарале агроеколошким условима међу сиромашним, неписменим и политички непристрасним.

Кључне ријечи: *мјере политике, технологија, продуктивност, приход, благостање, агроекологија.*