Crop Productivity and Multidimensional Poverty Reduction in Ghana

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ABSTRACT

This study estimated crop productivity and multidimensional poverty based on health, education, and living standards indicators in rural and urban areas and the agroecological zones of Ghana. The multidimensional poverty index was regressed on crop productivity with instrumental variable fixed and random effects models and pseudo panel data from the Ghana Living Standards Survey Rounds 5 and 6. The study found multidimensional poverty headcount ratio reduced 46% in 2005/06 to 34% in 2012/13 in Ghana. The multidimensional poverty headcount ratio reduced 49% in 2005/06 to 38% in 2012/13 rural and reduced 25% 2005/06 to 16% 2012/13 urban. The multidimensional poverty headcount ratio reduced 32%, 29%, and 60% in 2005/06 to 28%, 21%, and 45% in 2012/13 at the coastal, forest, and savannah agroecological zones, respectively. The study further showed that 1% growth crop productivity reduced multidimensional poverty by 0.17% disaggregated into 0.09% and 0.28% coastal and savannah agroecological zones respectively but marginally reduced at the forest zone.

Keywords Crop Productivity, Multidimensional Poverty, Capabilities, Living Standards, Instrumental Variable Regression

JEL Classification Q18 Q5 Q210 D6 C33

INTRODUCTION

Crop productivity growth depends on the adoption of technologies such as irrigation, fertilizers, and improved seeds. Bhutto and Bazmi (2007) observed that productivity growth depends on improved farm production technologies, market access, and a factor shift from the agriculture to non-agricultural sectors. Poverty is defined as a lack of basic material needs such as food, clothing, and shelter for an individual or family (McConnell *et al.* 2003). Income or consumption unidimensional poverty measures, such as the World Bank's dollar-a-day headcount ratio have been the most prevalent measures of poverty. Households that are consumption-poor might suffer malnutrition, are ill-educated, lack assets, and lack social amenities. Monetary poverty indicators may provide insufficient policy guidance on deprivation in other dimensions. Multidimensional measures of poverty or well-being identify multiple attributes or deprivations experienced by individuals in different dimensions which may typically include some measure of income or expenditure; they do not rely solely on the economic circumstances. Income is only one dimension of poverty; other indicators of welfare may better show the relative well-being of women- and female-headed households (Rogan, 2016).

Multidimensional measures indicating achievement below certain minimum levels reflect the complexity of well-being and poverty in that they convey the extent to which a person is poor in several distinct and

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independently important dimensions (Foster et al. 2010). Sen's definition of capabilities potentially leads to a long list of dimensions as functionings the lack of which defines poverty (Ravallion 2011). Sen's capabilities perspective informed the use of the Global Multidimensional Poverty Index based on three dimensions: health, education, and living standards (Alkire and Santos 2010). The pattern of multidimensional poverty among crop farmers show a decline or upward in poverty according to rural and urban disparities and agroecological zones in Ghana.

MATERIALS AND METHODS

Estimation of Multidimensional Poverty Index

The MPI is based on the method of Alkire and Foster (2009) and uses principles of Foster et al. (1984) who introduced a new class of poverty measures with axiomatic properties of additive decomposability and subgroup consistency enabling coherent evaluation of poverty across population subgroups. The asset indicators of multidimensional analysis capture the long-run household economic status and could be superior predictors of welfare rather than consumption expenditure (Sahn & Stifel, 2003). The asset index is not flawless because of the relatively slow change in asset holdings and it is less useful for measuring short-term changes in household economic status.

Health, education, and living standards dimensions were assigned weight of 3.33 (10/3). Health dimension (3.33) consists of malnutrition and wastage indicators which were assigned weight of 1.67 (3.33/2) respectively for deprived households. The education dimension (3.33) indicators include: household member has completed primary education and children between 6 and 12 years are not attending school were weighted 1.67 (3.33/2) for deprived households. Living standards dimension (3.33) has six indicators: lack of electricity, lack of portable water, lack of toilet facilities, lack of clean floor material, use of dirty cooking fuel and lack of durable assets were assigned weights of 0.56 (3.33/6) respectively for deprived households. Crop farming household deprivation scores were counted and households with deprivation scores greater than a cut-off of 3 (30% of the indicators) become multidimensionally poor and are denoted by q. The number of poor households q divided by the total farm households of n gives the proportion of households multidimensionally poor (H) as shown in equation (1).

$$H = \frac{q}{n} \quad (1)$$

The sum of deprivation weights c per total number of indicators (d) and total number of poor persons (q) is the extent of deprivation given by (A) in equation (2).

$$A = \frac{\sum_1^q c}{qd} \quad (2)$$

where c is the sum of weighted deprivations of the poor experience and d is the total number of indicators which is 10. The product of the multidimensional poverty incidence H and the extent of deprivation A is the Multidimensional Poverty Index (MPI) (Grewal et al. 2012).

$$MPI = H \times A \quad (3)$$

MPI is the proportion of the multidimensionally poor adjusted by the intensity of deprivation. The intensity of deprivation adjusts the multidimensional poverty headcount ratio by increasing or decreasing the deprivation. Data limitations constrain the dimensions, indicators, and unit of analysis for MPI as well as other methodological decisions. The decisions on the MPI parameters of deprivation cut-offs, weights, and poverty cut-off are based on normative arguments (Alkire & Santos 2010).

Effect of Crop Productivity on Multidimensional Poverty Index

Crop productivity (CROPPROD), x_1, was measured as crop income per hectare of land. Crop productivity was

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regressed on the instruments of cost of chemical inputs (k_1) (fertilizer, herbicides, and insecticides) and the cost of intermediate inputs (k_2) (fuel, transportation, repairs, and maintenance) as a first-stage regression (equation 4). Multidimensional poverty deprivation MPD(c) which is the dependent variable was regressed on the estimated crop productivity (CROPPROD), household size (HHS), livestock income (LIVY), and remittance income (REMY) as a second-stage regression (equation 5). The first and second stages of the instrumental variable regression model in equations (4) and (5) were estimated simultaneously using either a fixed effects or random effects estimator. The fixed-effects model assumes that independent variables have individual unobserved heterogeneity that causes endogeneity which is estimated using the fixed-effects model for unbiased estimates. The random-effects model accommodates the correlation between the independent variables and error term which makes the estimates both unbiased and consistent (Equation 6).

$$logCROPPROD = \alpha_0 + \alpha_1 logk_{1it} + \alpha_2 logk_{2it} \quad (4)$$

$$logMPD_{it}(c) = \beta_0 + \beta_1 logCROPPROD_{it} + \beta_2 logHHS_{it} + \beta_3 logLIVY_{it} + \beta_4 logREMY_{it} + \varepsilon_{it} \quad (5)$$

$$corr(x_{ij}, \epsilon_{it}) = 0 \quad (6)$$

The study employed the Ghana Living Standards Surveys 2005/06 and 2012/13. The study grouped the 2910 and 8355 farm households by age range of 15-20, 21-25, 26-30, 31-35, 36-40 etc., gender being male or female and agro ecological zones of coastal, forest, and savannah zones to constitute pseudo-panel data. Deaton (1985) suggests creating cohorts, based on some pre-determined characteristics that are time invariant, can substitute for panel data and have cohort means which generate unbiased and efficient estimates (Guillerm 2017).

RESULTS AND DISCUSSION

Multidimensional Poverty: Health, Education, and Living Standards Indicators

The study found that approximately 31% of farm households were malnourished in 2005/06 which decreased to 17% in 2012/13. The African region accounted for 39.4% of stunted children, which is a form of malnutrition. The new Sustainable Development Goals (SDGs) 1 and 2 state that extreme poverty and hunger can be eradicated by halving the number of people living on less than $1.25 per day and the number of people suffering from hunger (MICS, 2019). The study found that about 20% of farm households did not have children in school in 2005/06 which increased to 22% in 2012/13. In Ghana, 19% of school-going children did not attend primary school in 2017/18 (MICS 2019). Interventions introduced into the educational sector to increase enrolment include the Free Compulsory Universal Basic Education and School Feeding Programme (Owusu & Mensah 2013). Increasing access to education is vital for improving the overall health and longevity of a society, growing economies, and even combating climate change, which are related to sustainable development goal 4. The lowest level of deprivation was 3 percent for households that lacked at least six years of primary education for adults which was constant between 2005/06 and 2012/13. The study found that 78% of the households lacked access to electricity in 2005/06 which reduced to 60% in 2012/13. The study found that access to clean drinking water reduced slightly from 30% in 2005/06 to 29% in 2012/13. Basic Drinking Water is Sustainable Development Goal 6; drinking water from an improved source, provided collection time is not more than 30 min for a round-trip including queuing and the drinking water sources have the potential to deliver safe water by nature of their design and construction. These include piped water, boreholes, tube wells, protected dug wells, protected springs, rainwater, and packaged or delivered water.

The study revealed that households lacking toilet facilities increased 44% 2005/06 to 46% 2012/13. Basic Sanitation Services SDG 6 includes the use of improved sanitation facilities that are not shared with others (MICS 2019). The lack of clean cooking fuel deprivation had the highest score increasing from 92% 2005/06 to 94% 2012/13. Farmers mainly use wood, charcoal, and crop residues, among other dirty cooking fuels, for domestic purposes. The use of firewood and charcoal is less expensive but rapidly prevents regeneration of the forest and shifts to more environmentally friendly and safer Liquefied Petroleum Gas systems; however, it can

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save the forest and prevent respiratory diseases (EC 2006). The study found that approximately 24% of households 2005/06 lacked clean floor material which reduced to 20% 2012/13. Ghana needs about 85,000 housing units annually to solve overcrowding and homelessness and limit the effects of rainfall (GSS 2014). Households that lack durable assets such as mobile phones, radio, television, cars, etc. reduced 40% 2005/06 to 34% 2012/13 (Table 1).

Table 1: Multidimensional Poverty Indicator Deprivations (%)

Indicator	**Deprivation (%)**	
	2005/06	**2012/13**
Malnutrition	31	17
Wasting	23	19
Lack of Adult Primary Education	3	3
Children absent from School	20	22
Lack of Electricity	78	60
Lack of Clean Drinking water	30	29
Lack of toilet facility	44	46
Lack of Clean cooking fuel	92	94
Lack of Clean Floor material	24	20
Lack of Durable Assets	40	34

Ghana Living Standards Survey Rounds 5 & 6

Multidimensional Poverty Headcount Ratio Rural and Urban and Agroecological Zone

The estimates of the multidimensional poverty headcount ratio indicate the proportion of households that are multidimensionally poor in health, education, and living standards indicators. The product of the multidimensional poverty headcount ratio and intensity of deprivation by the weights of the indicators of health, education, and living standards is the estimate for the multidimensional poverty index which ranges zero to one. Multidimensional poverty index values close to one indicate higher intensity of multidimensional poverty. Crop farmers multidimensional poverty headcount ratio reduced 46% in 2005/06 to 34% in 2012/13 by 12 percentage points in Ghana (Table 2). The multidimensional poverty headcount ratio reduced 49% 2005/06 to 38% 2012/13 rural areas and reduced 25% 2005/06 to 16% urban areas 2012/13. The multidimensional poverty headcount ratio reduced 32%, 29%, and 60% in 2005/06 to 28%, 21%, and 45% in 2012/13 at the coastal, forest, and savannah agroecological zones of Ghana. The multidimensional poverty headcount ratio decreased significantly between 2005/06 and 2012/13 and was higher rural areas than urban areas. The multidimensional poverty rates were lower in the coastal and forest zones than in the savannah zone. The multidimensional poverty index decreased 0.21 2005/06 to 0.15 2012/13. The multidimensional poverty index decreased 0.22 2005/06 to 0.16 2012/13 rural and decreased 0.11 2005/06 to 0.07 2012/13 urban areas in Ghana. The multidimensional poverty index was higher rural areas than urban areas. The multidimensional dimensional poverty index reduced 0.14, 0.13, and 0.28 2005/06 to 0.11, 0.09, and 0.20 2012/13 respectively in the coastal forest and savannah agroecological zones of Ghana. The multidimensional poverty index was lower in coastal and forest zones than savannah agroecological zones in Ghana.

Table 2 Multidimensional Poverty Index by Rural and Urban and Agroecological Zone

Multidimensional Poverty Headcount Ratio (%)			**Multidimensional Poverty Index**	
	2005/06	**2012/13**	**2005/06**	**2012/13**
Rural	49	38	0.22	0.16

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Urban	25	16	0.11	0.07
Coastal	32	28	0.14	0.11
Forest	29	21	0.13	0.09
Savannah	60	45	0.28	0.20
National	46	34	0.21	0.15

Ghana Living Standards Survey Rounds 5 & 6

Effect of Crop Productivity on Multidimensional Poverty Index by Agroecology

The results indicate that 1% growth crop productivity reduced multidimensional poverty deprivation by -0.17% among farm households in Ghana (Table 3). The findings of the study further revealed that 1% growth crop productivity significantly reduced multidimensional poverty deprivation by -0.09% in the coastal zone and -0.28% in the savannah zone but had no effect in the forest agroecological zone. Agricultural productivity growth 1% reduced the Human Development Index by 0.12% in the developing world (Irz et al., 2001). The results indicate that 1% increase household size leads to 0.27% increase multi-dimensional poverty deprivation. The study further reveals that 1% increase household size increased the multidimensional poverty deprivation by 0.23%, 0.21%, and 0.31% in coastal, forest, and savannah zones, respectively. The study further reveals that increasing livestock income by 1% reduced multidimensional poverty deprivation by -0.0115% in the forest zone but increased multidimensional deprivation by 0.0205% in the savannah zone. Furthermore 1% increase remittance income reduced multidimensional deprivation by -0.0182% in all the agroecological zones and by -0.0274% and -0.0147% in the forest and savannah zones respectively.

Table 3: Effect Of Crop Productivity on Multidimensional Poverty Index

Variables	All zone	Coastal	Forest	Savannah
Crop productivity	-0.170***	-0.0932**	-0.0411	-0.284***
	(0.0151)	(0.0440)	(0.0262)	(0.0199)
Householdsize	0.269***	0.225***	0.210***	0.311***
	(0.00957)	(0.0362)	(0.0160)	(0.0126)
Livestock Income	0.00415	-0.00850	-0.0115*	0.0205***
	(0.00318)	(0.0111)	(0.00635)	(0.00395)
Remittance Income	-0.0182***	0.0115	-0.0274***	-0.0147***
	(0.00250)	(0.00947)	(0.00402)	(0.00338)
Constant	-0.861***	-1.327***	-1.649***	-0.188*
	(0.0895)	(0.257)	(0.158)	(0.114)

Ghana Living Standards Survey Rounds 5 & 6

CONCLUSION

The multidimensional poverty rate of crop farmers reduced between 2005/06 and 2012/13 and was lower in urban areas than rural areas and higher savannah agroecological zone than in the coastal and forest agroecological zones. The study further found that crop productivity reduced the multidimensional poverty index and the effect was stronger in the savannah agroecological zone than in the coastal and forest zones. This study recommends policy on crop productivity growth through the adoption of improved inputs, access to the market, infrastructure, etc., to increase food provision and income to reduce multidimensional poverty in rural and urban areas and the agroecological zones.

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Competing Interest

No potential conflict of interest is reported by the authors.

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