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PARTICIPATION AND YIELD EFFECT OF GHANA'S PLANTING FOR FOOD AND JOBS PROGRAMME IN BUNKPURUGU-YUNYOO DISTRICT

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ABSTRACT
It is always important to evaluate the performance of agricultural interventions as early as possible in order that subsequent implementation could benefit from lessons learned from successes and failures. This paper examined the effect of participation in Ghana's Planting for Food and Jobs programme on maize yields in the Bunkpurugu-Yunyoo District of Northern Region. Data from a cross-section of maize farmers was analyzed using the Heckman treatment effects model. The results showed that participants of the PFJ programme obtained higher yields than the non-participants by about 4 bags per acre. However, some farmers still face the challenges of limited access to fertilizer, late delivery of inputs, and low access to extension services which tend to limit the potential outcomes to be realized from the intervention. Therefore, the programme implementers, particularly the Ministry of Food and Agriculture (MoFA) should ensure expanded access and timely delivery of inputs, to help enhance the realization of the PFJ policy objectives as well as ensure effective extension supervision.

Keywords: Planting for Food and Jobs, Heckman treatment effect model, capability, Bunkpurugu-Yunyoo, northern Ghana.

BACKGROUND AND PROBLEM
Agriculture has a direct and important role to play in attaining the second pillar of the sustainable development goals (SDGs) due to its position as a key driver of the Ghanaian economy. The second pillar of the SDG aims to end hunger, improve nutrition and promote sustainable agricultural development. The agricultural sector employs close to 40% of the active labor force [Ghana Statistical Service (GSS, 2017)], and provides revenue for Government businesses. Though the sector's contribution has been enormous in the past, recent growth and performance indicators have not matched up to expectations (GSS, 2017). This is attributed to the low agricultural productivity which is also a threat to livelihoods and natural resources. With low productivity, agricultural output growth tends to be driven largely by extensification (land expansion), which is environmentally unsustainable and also fails to address poverty and malnutrition (Ashley and Maxwell, 2011). With Ghana's population expected to reach 30.5 million at an annual growth rate of 2.36% by 2020 (World Population Prospects, 2015), there is much expectation from the agricultural sector to increase food production, and provide income and employment along the value chain [Ministry of Food and Agriculture (MoFA, 2017)].

Agricultural development through productivity growth could lead to the migration of labor from the rural farm sector to rural non-farm and urban economies, on the grounds of Lewis theory of development (Dang and Sui Pheng, 2015; Todaro and Smith, 1977). This theory seems to be well understood by current and past governments in Ghana, and therefore continue to introduce policies aimed at revamping the agricultural sector. Notable among these policies is the

fertilizer subsidy programme which was introduced in 2008 by the government of Ghana [Food and Agriculture Organization (FAO, 2015)] to motivate farmers to improve productivity and food supply. However, after almost a decade of being implemented fertilizer use among smallholder farmers still remains significantly low (FAO, 2015). Other policies and investment plans introduced by previous governments include the Food and Agriculture Sector Development Policies (FASDEP I and II) and Medium-Term Agriculture Development plans, METASIP I and II (2014-2017).

A current initiative of Ghana government is the Planting for Food and Jobs (PFJ) programme which started in 2017. The PFJ programme aimed to modernize agriculture, improve yields, achieve food security and make farming more profitable to farmers through increased agricultural productivity (MoFA, 2017). The PFJ programme is designed and expected to mirror the one-time ''Operation Feed Yourself'' (OFY) programme that was implemented in the 1970s, and hinges on five key pillars, which are: (1) provision of improved seeds, (2) supply of fertilizers, (3) provision of dedicated extension services, (4) marketing and (5) e-agriculture and monitoring of farmer activities.

According to MoFA (2017), a successful implementation of the PFJ programme is projected to increase maize yields by at least 30%, rice yields by 49%, soybean by 25% and sorghum by 28%. The overall goal of the PFJ policy is to enhance agricultural productivity, improve incomes as well as solve the problem of food insecurity. Achieving this goal of productivity enhancement depends on farmers' participation in the PFJ programme. As defined by Nxumalo and Oladele (2013), participation refers to the involvement of individuals and groups in development processes with the aim of ensuring self-reliance and better standard of living, while Farid et al. (2009) describes it as taking part in an activity usually with others. Etwire et al. (2013) notes that farmers' participation in agricultural interventions relates directly to the environment, their nutrition and poverty levels, as well as agricultural sector and macroeconomic performance.

Since the PFJ programme was implemented in 2017, there is not yet an evaluation of its outcomes in order to document successes and failures. The knowledge of successes and failures is necessary to advice and guide policy implementation in subsequent years, since the PFJ is a long-term programme. The desire to generate such important knowledge drives this study. Therefore, the objective of the current study is to assess the effect of participation in the PFJ programme on maize productivity. er We focus on maize because, according to Musah et al. (2013) maize has a high potential of increasing incomes of subsistence farmers, in addition to being a major staple.

We acknowledge the work of Donkoh et al (2016) that evaluated the performance of Ghana's Block Farm Credit Programme (BFCP) as useful in terms of evaluating past programmes in the Ghanaian context. This work found that the BFCP was successful at increasing the output of farmers, but there was need to address key challenges to make the programme more successful. While this paper made important contribution to our understanding of programme performance in Ghana, the evaluation came much later after the programme had ended. Hence, useful lessons from the paper could not be utilized by policymakers. It is in this light that we consider an early evaluation of major policy decisions and programmes like the PFJ as necessary and useful, hence our study.

The rest of the paper is organized into 3 sections as follows. Section 2 outlines the methodology employed to achieve the stated objectives. In section 4, the results from the data analysis are presented and discussed, while section 5 presents a conclusion and policy implications.

MATERIALS AND METHODS

Study Area

Bunkpurugu/Yunyoo District is positioned in the north-eastern corner of the northern region of Ghana, with a land mass of approximately 1,257 square kilometers and a population density of about 98 persons per square kilometer. The district lies in the tropical continental western margin and experiences a single rainfall, with a maximum in May to October. The climatic characteristics include a mean annual precipitation of between 100 mm to 155 mm rain, while the annual temperature ranges between 30ºC to 40ºC (Ghana Population and Housing Census, 2010). The district lies in the interior woodland savannah belt and has a vegetation of grasses interspersed with few sheanut trees, baobab and neem. Based on the 2010 census, about 97.9% of the households in the district engage in crop farming with maize being the dominant crop.

To select the respondents, a multi-stage sampling technique was used. In the first stage, a stratified random sampling was used to put the study area into 3 strata based on ethnic lines. In the second stage, 5 communities were selected from each stratum using simple random sampling. Table 1 reports the strata and corresponding communities chosen.

TABLE 1: ETHNIC ZONES WITH THEIR RESPECTIVE COMMUNITIES SAMPLED FOR THE STUDY

Ethnic zone	Communities
Bimoba	Bimbago Nakpanduri, Tomoni, Kambateak, Bunkpurugu
Konkomba	Bimbago south, Nassuan, Janandel, Jimbale, Kpemale
Mamprusi	Bende, Yunyoo, Badimsuguru, Guangbeang, Jinwol

Data collection took place in the months of December 2017 and January, 2018, with a structured questionnaire used as the research instrument. Information on socioeconomic characteristics, dwelling characteristics, land ownership and use incomes, political participation, markets, e-agriculture and PFJ programme participation challenges, among others were solicited. The sample included 134 participants, 9 from each community were randomly selected. The remaining 180 respondents, 12 from each community, were non-participants who were also randomly sampled. In total, about 314 respondents in the district were sampled and interviewed face-to-face. After data entry and cleaning, 302 respondents were correctly entered for data analysis.

Empirical Framework

Econometric model on the effect of participation in the PFJ programme on maize yield

We assessed the effect of participation in the PFJ programme on maize yield (y) using the Heckman treatment effect model, given in equation (1).

$$y = b_0 + +b_2\, seedtype + b_3 labour + b_4 market + b_5 nf_{income} + b_6\, fertilizer + \gamma PFJ + e \quad (1)$$

We employed this approach because, we suspected that the participation variable may not be strictly exogenous due to several reasons. First, participation in the PFJ might be influenced by unobserved factors, such as risk behavior and entrepreneurial ability on the part of the farmers. This would mean that $cov(PFJ, e_i) \neq 0$, a case of endogeneity due

to sample selection bias. The PFJ programme package, especially the fertilizer and certified seeds, even though are subsidized, come with partial costs that must be defrayed after harvest. Some farmers are natural risk-averse, and for the fear of the unknown, might be unwilling to participate. It is also possible that farmers who may participate are naturally better at farming, and therefore might get higher yieldsts even if they do not participate in the PFJ programme. If these unobserved effects are not properly handled, we might not be able to measure the true effect of the PFJ programme on maize yield.

Due to endogeneity from sample selection bias, a probit model in equation (2) is first estimated to generate an inverse mill ratio (IMR) which is then included as an estimator in the outcome equation to correct for the sample selection bias.

$$PFJ^* = \alpha_0 + \alpha_1 age + \alpha_2 farm_{distnace} + \alpha_3 access_{road} + \alpha_4 institutional_{capability} + \alpha_5 human_{capability} + \alpha_6 land\ size + \alpha_7 experience + \alpha_8 sex + \alpha_9 ethnicity + \alpha_{10} number\ of\ years\ of\ education + v \quad (2)$$

The dependent variable in the probit, PFJ assumes a dummy with participants coded 1 and 0 for non-participants. The latent dependent variable (PFJ^*) is observed through the decision to participate or not such that

$$PFJ = \begin{cases} 1 & if\ PFJ^* > 0 \\ 0 & if\ PFJ^* \leq 0 \end{cases}$$

In the probit analysis, the effects of variables that influence participation decisions are estimated. Table 2 presents the definition of variables and expected signs.

TABLE 2: EXPLANATORY VARIABLES AND THEIR HYPOTHESIZED EFFECTS ON THE YIELD MODEL

Variable	Definition and measurement	A priori expectation
Nf_income	1 if farmer earns non-farm income, 0 otherwise	+
Market	1 if farmer has ready market for output, 0 otherwise	+
Seed	1 if farmer planted local seed variety, 0 otherwise	+
Labor	Number of man-days employed for the production activities	+
Fertilizer	Amount of fertilizer applied (kilograms)	+
Farm_size	Size of land cultivated to maize (acres)	+
PFJ	1 if farmer participated in the PFJ in 2017 cropping season, 0 otherwise	+
Age	Age of a farmer in years	+
Farm_distance	Distance from house to farm (Minutes by walking)	_
Access_road	Distance from home to the nearest access road (Minutes by walking)	_
Land	Total land owned (acres)	+
Experience	Number of years spent in farming	+
Sex	Dummy: 1 if male, 0 female	+
Ethnicity	Dummy: 1 if Bimoda, 0 if Kokomba	+
Institutional_capability*	Index, quantified through factor analysis based on Likert scale questions that relate to capability in maize-based farming systems	+
Human_capability*	Index, quantified through factor analysis based on Likert scale questions that relate to capability in maize-based farming systems	+

Notes: **see appendix I for the Likert scale questions and factor analysis used to quantify the two attributes of capability in maize-based farming systems*.

RESULTS AND DISCUSSIONS

Distribution of Institutional Variables in the Study Area

During the survey, information was collected on five institutional variables, namely access to credit, extension services, existence of agro-input markets, existence of output markets and land tenure system. As shown in Table 3, a significant number of participants (41.72%) and majority of non-participants (53.64%) in the PFJ programme did not have access to credit from any financial institution for their farming activities. Similarly, about 44.04% of participants and 54.30% of the non-participants had no access to agricultural extension services during the production period under recall. This inadequate access to extension service limits farmers' access to information regarding their farming activities.

On access to input and output markets, the results showed that 34.44% and 36.75% of the non-participants said they had no access to input and output markets respectively in their resident communities. Due to this, they had to travel long distances to nearby towns to buy inputs. On the other hand, 21.19% and 18.87% of the non-participants indicated that they had access to input and output markets respectively in their resident communities. Considering the participants, 11.59% said they had no access to input markets, while 8.94 % had no access to output markets in their resident communities. Those who had access were 32.78% to inputs markets and 35.43% to outputs markets. This distribution indicates that most of the non-participants had no access to markets, which could affect their capability to

participate in the PFJ programme. This is because the availability of infrastructure like markets in the locality limits the stress faced by farmers' when it comes to accessing inputs and outputs.

In relation to land ownership, 43.38% of the participants in the PFJ programme owned their lands, while 8.28% acquired land through other tenure arrangements. Similarly, 36.09% of the non-participants owned their lands with the remaining 12.25% being non-land owners. In other words, those who owned lands participated more than those who acquired land through other tenure arrangements

TABLE 3: DISTRIBUTION OF MAIZE FARMERS BASED ON ACCESS TO INSTITUTIONAL FACTORS

Institutional Variable	Response	Participants (%)	Non-participants (%)
Access to credit	Yes	2.65	1.96
	No	41.72	53.64
Access to extension services	Yes	0.33	1.32
	No	44.04	54.30
Agro-input market in community	Yes	32.78	21.19
	No	11.59	34.44
Output market in community	Yes	35.43	18.87
	No	8.94	36.75
Type of land ownership	Rented	8.28	12.25
	Own	43.38	36.09

Source: Field survey, 2017/2018

Results from the Heckman Treatment Effects Model

Results of the socio-economic, capability as well as production variables used in determining the effect of farmer participation in the PFJ programme on maize yield are shown in Table 4. The Lambda is negative and significant at 1% indicating that there is sample selective bias, and that unobserved factors that make participation more likely tend to be associated with yield. From the analysis, the Wald chi-square test at 6 degrees of freedom is 128.18 and an associated p-value of 0.0001. This indicates that the model gives a good fit for the data. Out of the ten variables in the probit selection equation, age, distance to the nearest access road, institutional capability, human capability, total land size and farm experience, sex, ethnicity were all significant in determining the decision to participate in the PFJ programme. Also, out of the five variables used in the outcome equation, quantity of fertilizer, non-farm income and participation in the PFJ programme were statistically significant determinants of maize yield.

Determinants of participation in the PFJ programme

From Table 4, all the variables in the probit selection equation were significant except distance to the nearest access road and number of years of education. Specifically, age, institutional capability, human capability, land, sex, ethnicity and farm experience had a positive effect on participation in the PFJ programme, while distance from house to the farm had an inverse relationship. These findings are consistent with the work of Omotesho et al. (2016), on farmer participation in agricultural programmes in Nigeria that the level of participation of Kwara State farmers in group activities was influenced by farm size. Also, Kimaro et al. (2015) found that socio-economic characteristics were crucial in determining whether an individual would participate in an agricultural activity or not. The positive and significant effect of experience could be attributed to the fact that households with more experience in maize farming might have

over the years participated in similar agricultural programmes and understood its contribution to higher agricultural performance. Such experienced farmers may also have reliable channels of selling produce and therefore have better hopes of repaying the cost of the technology package after harvest.

TABLE 4: HECKMAN TREATMENT EFFECT MODEL RESULTS

Variable	Marginal effects	**Std. Error**
Selection equation (PFJ participation)		
Age	0.009***	0.0033
Distance from house to the farm	-0.003**	-0.0014
Distance to the nearest access road	-0.001	-0.007
Institutional capability	0.280***	0.0564
Human capability	0.111**	0.0519
Total land size	0.0369***	0.0085
Farmer's experience	0.006*	0.0036
Sex	0.179*	0.11674
Number of years of education	-0.003	0.0090
Ethnicity	0.246**	0.1062
Constant		0.5541
Outcome equation (Yield[1])		
Ready market	0.263	0.2589
Type of seed sown	0.485	0.34814
Labour	-0.008	0.0069
Non-farm income	0.469**	0.2328
Quantity of fertilizer	0.001*	0.0005
PFJ participation	**3.621*** **	**0.4132**
Constant		0.48569
Rho		*-0.433*
Sigma		*1.977*
Lambda		*0.268*

*NB: ***, ** and * denotes 1%, 5% and 10% significant levels respectively.*

The factor analysis shows that the responses to the statements were best described by two factors that represent two attributes of capability in maize-based farming systems as indicated above. The two factors accounted for 86.4% of the variance (see Appendix B) in capability. The first factor accounted for 55.8% of the variance, and consists of nine statements which relate to access to fertilizer, improved seeds, access to extension staff, access to credit, access to market at better prices, unrestricted access to inputs, and level of education, experience and political participation. The second factor, accounting for 30.6% of the variance, captured five statements in the rotated factor solution, and related

[1] Farm size or land is not included in this equation because we divide the output by farm size to obtain the yield, which is the dependent variable in this model.

to knowledge on how to apply inputs, having voice in making decisions regarding farming, access to non-farm income sources, gender and mode of land acquisition.

The positive effects of institutional and human capabilities on PFJ programme participation was also envisaged. It has been documented that inequalities in capabilities and functioning are often due to lack of equal access of conversion factors and other socio-environmental constraints (Tsai, 2011, Smith, 2016). Since institutional capability has a positive effect on farmer participation in the PFJ programme, bridging the gap of inequality in capability through provision of institutions and infrastructure can facilitate farmers' participation in the programme. All else equal, if all institutions that have a link with agricultural sector perform up to expectation, farmers' institutional capability would be improved. This is because institutional capability relates to factors such as access to extension and markets. Availability of markets and extension services could serve as an incentive for farmers to involve themselves in agricultural programmes like the PFJ. Sen (2002) adds his voice by indicating that individuals think, choose or act in line with the society they belong, and that freedom of choices are critical in helping to develop human capability. Since human development involves the enlargement of people's capabilities (Sen, 1999), there is the need for conducive social and environmental conversion factors. This helps one to convert commodities (resources) into functionings (realized outcomes), though there are often specialized forces of injustice that constrain capabilities by external forces beyond the control of the individual (Nussbaum, 2001, Sen, 1999).

Furthermore, the negative effect of distance from home to the farm also meets *a priori* expectation. The closer the distance from home to the farm, the less stress involved in carrying out farming activities in terms of transportation of inputs and outputs. For that matter, farmers who are closer to their farms are able to put their internal capabilities to full utilization due to the proximity of their homes to the farms. Since distance from farmer's home to the farm is a function of cost, it means that farmers who live far away from their farms are less likely to participate in the PFJ programme compared to farmers who live closer to their farms. In addition, the positive effect of the gender variable informs that male-headed households are more likely to participate in the PFJ programme than female-headed households. Besides having unrestricted access to land and other productive resources, males have enriched human capability in terms of political participation which makes them more influential when it comes to participating in political activities and related programmes like the PFJ compared to their female counterparts in the study area. Ethnicity is also a significant determinant of PFJ programme participation. The result indicates that Bimobas participated more in the PFJ programme. This outcome is not surprising since majority of the Bimobas tend to be relatively more active participants of social and political events than Konkombas, who are often the minority group.

Effect of PFJ participation on maize yield

The key objective of this study was to evaluate the effect of participation in the PFJ programme on maize yield. The result in Table 4 showed that not only was PFJ participation having influence on maize yield but also confirms a positive *a priori* expectation that PFJ programme participation. According to FAO (2015), agricultural sector development is a major priority for the Government of Ghana. This is evidenced by the prioritization of agri-food production and export since 2007, with much emphasis on agricultural modernization, while ensuring minimum prices for farmers (FAO, 2015). The result indicates that farmers who participated in the PFJ programme had higher yields of about 4 bags per acre, holding all other factors constant. This outcome is consistent with the findings of Donkoh et al (2016), that farmers who participated in the Block Farm Credit Programe (BFCP) in selected districts of Northern Ghana obtained about 10% higher crop value than those who did not participate. This result also justifies the programme in line with the

government's priority of increasing agri-food production. Increase in agricultural productivity is a step in the right direction. This is because low productivity in the agricultural sector, especially the agri-food sector, does not only serve as a threat to livelihoods due to food insecurity and poverty, but also leads to environmental degradation through extensification (Ashley and Maxwell, 2011). The result means that unlike non-participants, farmers who participated in the PFJ programme had access to larger quantities of inorganic fertilizers and probably improved seeds, which led to improvement in their yields.

From the results, apart from non-farm income and quantity of fertilizer applied, which are significant and meet *a priori* expectation, other variables like type of seed sown, labour and market are insignificant in the model. Among the conventional production factors, only the quantity of fertilizer applied was positive and statistically significant at 1%. This is indicative that it pays to invest in maize production through increased fertilizer use. Naturally, soils in sub-Saharan Africa lack most of the important soil nutrients. The application of inorganic fertilizer tends to improve soil fertility, and this helps crops to grow better and give higher yields, as observed in this study. A combination of organic and inorganic fertilizers could have a cumulative effect in enhancing crop productivity through better soil amendment. Furthermore, non-farm income was found to have a positive influence and statistically significant at 5%. So besides PFJ participation, farmers with non-farm incomes have higher yields. This result is plausible because non-farm income enhances the financial capability of farmers such that they can afford purchased inputs like fertilizer and improved seeds, which leads to positive effect on productivity or yield.

Challenges faced by participants and non-participant maize farmers

During the survey, participant farmers were asked to state, out of six pre-selected challenges, the one they consider as a major one affecting their farming activities. It is important to note that we did not present these challenges in the form of multiple responses, because we were interested in knowing the single most important challenge that concerns the PFJ implementation. As shown in Table 5, it turned out that limited access to fertilizer was the major challenge identified by about 54% of the participants. Besides access to fertilizer, late delivery of inputs and low access to extension services followed next. On the other hand, the table results show that farmers did not have a problem with access to improved seeds and army worm infestation.

TABLE 5: CHALLENGES FACED BY PARTICIPANTS OF THE PFJ PROGRAMME

Challenge	Yes (%)	No (%)
Limited access to fertilizer	53.57	46.43
Limited access to improved seeds	1.19	98.81
Restricted access to markets	5.36	94.64
Low access to extension service	13.69	86.31
Lack of agricultural information	6.55	93.45
Late delivery of inputs	17.86	82.14
Armyworm infestation	1.79	98.21

Source: Field survey, 2017/18

The fact that more than 50% of the participants had challenges with the fertilizer access signifies existing challenges that require the attention of the programme implementers. In terms of productivity enhancement, fertilizer application is key. The other important aspect was improved seeds, which the results indicate farmers did not see that as a major problem. During the survey, farmers often mentioned that the delay in getting the inputs often affect the performance

of their crops. Thus, these core issues need to be addressed in order to improve the effectiveness and efficiency of the PFJ programme.

CONCLUSION AND RECOMMENDATIONS

We aimed to ascertain the effect of participation in the ongoing PFJ programme on the yield of maize farmers in the Bunkpurugu-Yunyoo district. Due to the potential endogenous nature of the participation variable, we used a Heckman treatment effect model to undertake this exercise.

The results gave backing to PFJ programme because participation in the PFJ has statistically significant influence on maize farmers' yields. Specifically, holding everything else constant participants of the PFJ programme realized about 4 bags per acre more than the non-participants. Despite this welcoming news, farmers spoke about some challenges that must be addressed so that the full benefits of the programme could be realized. Farmers mentioned critical challenges to include limited access to fertilizer, late delivery of inputs and low access to extension services.

Policy-wise, one could argue that the PFJ programme is worth its investment, at least from a productivity point of view. However, the programme implementers (largely Ministry of Food and Agriculture) should help improve access to inputs through the establishment of community or village markets. They also have to expand the scope of the intervention package to include extension services, as some farmers pointed to limited access to extension services as a major constraint. Furthermore, inputs should be delivered on time so that farmers can apply them to their farms at the right time, since agricultural activities are always at the mercy of the weather. Finally, effective monitoring and supervision of the farmers' activities could help realize the expected outcomes so that the costs of the intervention packages could be readily reimbursed.

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APPENDIX

Likert scale questions and factor analysis for quantifying capability in maize-based farming systems in Bunkpurugu-Yunyoo district.

Appendix A: Indicators (statements) for measuring capability in maize-based farming systems in Bunkpurugu-Yunyoo District

Statements*	Mean	SD (%)	D (%)	N (%)	SA (%)	A (%)
I am able to access fertilizer and agro-chemicals without much obstacles	3.48	9.93	59.93	0.33	1.99	27.81
I am able to have relevant information and knowledge on how to use fertilizer and other agro-chemicals	1.64	1.66	1.66	-	44.04	52.65
I am able to have access to improved maize seeds whenever I deem necessary	3.93	13.25	77.15	-	0.66	8.94
I am able to have unrestricted access to extension staff and extension information	3.98	8.28	87.09	-	1.32	3.31
I am able to have access to credit for investment in maize production	3.81	8.94	77.48	0.33	0.66	12.58
I am able to have access to market for my maize produce and at better prices	3.25	10.26	48.34	0.33	2.65	38.41
I am able to have voice in decisions regarding maize farming	2.09	3.31	9.60	-	20.53	66.56
I am able to have access to non-farm income sources, which determines my level of investment I make in farm lands	3.15	6.62	48.01	0.33	1.92	49.71
I have unrestricted access to inputs at any time I wish to apply to my maize farm	3.55	7.28	67.88	0.66	2.98	21.19
My gender plays a role in getting access to land	2.60	5.30	25.50	0.33	6.95	61.92
My mode of land acquisition determines my level of investment	2.64	3.31	30.46	0.33	7.28	58.61
My level of education determines access to farm land	3.38	7.95	58.94	0.33	3.64	29.14
My experience in farming determines the level of investment I make in farm lands	3.16	8.94	46.03	0.33	3.31	41.39
My level of political participation determines my access to inputs	3.64	9.93	67.88	0.99	2.65	18.54

NB: SD = strongly disagree; D = disagree; N = neutral; A = agree; SA = strongly agree.

**Statements were measured using a 5-scale for all the items: 1-strongly agree, 2-agree, 3-neutral, 4-disagree, 5-strongly disagree. However, during data processing and analysis, these items were rescaled from 2 (strongly agree) to -2 (strongly disagree). This rescaling made it possible for higher values to correspond to increasing capability.*

Appendix B:: Factor analysis and indicators of capability in maize-based farming systems

Indicators of capability	Unrotated solution		Oblimin rotated solution		Uniqueness
	Factor 1	*Factor 2*	*Factor 1*	*Factor 2*	
I am able to access fertilizer and agro-chemicals without impediments	0.461		0.461		0.7209
I am able to obtain relevant knowledge on how to use fertilizer and other agro-chemicals		0.316		0.322	0.7948
I am able to have access to improved maize seeds whenever deem necessary	0.560		0.554		0.6337
I am able to have unrestricted access to extension staff and extension information	0.390		0.430		0.7283
I am able to have access to credit for investment in maize production	0.324		0.352		0.7755
I am able to have access to market for my maize produce and at better prices	0.456		0.455		0.6942
I am able to have voice in decisions regarding maize farming		0.607		0.633	0.5663
I am able to have access to non-farm income sources, which determines my level of investment I make in farm lands		0.302		0.323	0.7933
Due to my gender, I'm able to get easy access to land		0.373		0.438	0.6861
I am able to access to inputs at any time I wish to apply on my maize farm without restriction	0.351		0.351		0.7277
The nature on my access to land affects the level of investment I make in the farm				0.342	0.7568
The level of education I have makes me able to access farmland without hassle	0.428		0.410		0.7132
The level of experience I have in farming affects the level of investment I make in the farm	0.414		0.462		0.7119
The level of political participation makes me able to have ready access to inputs I need	0.476		0.495		0.6907
Model characteristics					
Eigenvalue of factor	2.07658	1.14128	2.04208	1.23199	
Proportion of variance explained by factor (%)	55.75	30.64	54.82	33.07	

NB: *Statements were measured using a 5-point Likert-scale for all the items: 1-strongly agree, 2-agree, 3-neutral, 4-disagree, 5-strongly disagree. However, during data processing and analysis, these items were rescaled from 2 (strongly agree) to -2 (strongly disagree). This rescaling made it possible for higher values to correspond to increasing capability. Selected factors have eigenvalues greater than 1; selected variables have factor loadings larger than 0.3; Total variance accounted for is 86.4%.*