GENDER PRODUCTIVITY DIFFERENTIALS IN SOUTH GUNIEA SAVANNAH RE-GION OF NIGERIA: A CASE STUDY OF DROUGHT TOLERANT MA1ZE VARIETY ON-FARM TRIALS.

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INTRODUCTION

Empirical evidence have shown that the use of drought tolerant (DT) maize varieties stabilize maize yields in the DT-prone ecologies and also increase land area cultivated to maize. The corollary is an enhancement in the economic status of the resource-limited farmers in the zone. The drought tolerant maize varieties are especially targeted towards the poor and resource limited farming household in the more marginal rain-fed agricultural areas. This resource limited farmers include rural women. Rural women are responsible for up to 60 to 80 percent of food production in developing countries, yet they are often underestimated and overlooked in technological innovation, policies and strategies. Despite women's role as key players in the agricultural sector, men have continued to dominate farm decision making, which could be counter-productive, due to conflicts that arises when women are not involved in the decision process. Men and women within households do not have the same preferences nor pool their resources. This has important implications for productivity. This necessitate gender inclusion in agricultural research. The rationale for considering gender in agricultural research relates to agricultural productivity, food security, nutrition, poverty reduction and empowerment. In all of these cases, women play a critical, but often under-recognized role and face greater constraints than men. Recognizing this sets the stage for identifying ways that the agricultural research system can redress these problems and contribute to productivity and equity.

Women are a key part of the mainstream in agriculture, yet they face formidable obstacles (CIMMYT, 2012). It is therefore of importance to have strategy to put men and women's concerns and experiences at the center of research design, implementation, monitoring, and evaluation. This involves looking at the socioeconomic settings of men and women to ensure that they benefit equally – often referred to as "gender mainstreaming." Filling the gap in access to technology between men and women, we could increase productivity (Food and Agriculture report (2010-2011) by the Food and Agriculture Organization of the UN (FAO). And it can contribute to child survival and nutrition, as "women are key to household food security." Gender shapes patterns of power relations, asset and wealth distribution and control, labor allocations, as well as preferences and aspirations within households. Gender is moving from neutrality to awareness and finally to gender transformative program design and implementation. Gender "aware"— that is, not only generating gender disaggregated data on the stakeholders that benefit from their development work — but transformation lies in using that information to improve the products and services delivered, paying specific attention to women's preferences. Research and innovations that would reduce the drudgery of farm work for women and meeting their needs is also important. Paying attention to women's needs and voices in the selection of maize varieties, we make it possible to meet their needs.

Since the inception of the Drought Tolerant Maize for Africa (DTMA) project activities in 2007 cropping season, the best four (4) entries within each of the early and intermediate/late maturing DT varieties, which have demonstrated superiority for grain yield, have been selected annually for testing under farmer's growing conditions in zone. As of date, more than 40 DT open pollinated varieties (OPVs) of maize have been tested in farmers' fields either as a combination of Mother and Baby trials, described by Snapp (2002) or as on-farm trials, in which two (2) DT OPVs are tested in farmers' fields with the farmer's variety as the check in three states (Kwara, Niger and Oyo) in the SGS. The Mother-Baby approach tests a number of different technologies (in this case DT maize varieties) in a central location (Mother trial) while the Baby trial tests a subset of the technology, which in this case, consisted two (2) of the DT varieties along with farmer's variety (control) in farmers' fields, scattered around the central location (Mother trial). However gender inclusion of DTMA trials started from 2012 till 2015.

Gender is a concept that refers to the range of roles and relationships, status, attitudes and behaviours, all determined by the social and cultural constructions of men and women, in a given society at a given time (Serme, 2013). The role that women play and their position in meeting the challenges of agricultural production and development are quite dominant and prominent. Their relevance and significance, therefore, cannot be overemphasized (Rahman, 2008). The various contributions of women to agricultural production in Nigeria have been variously described in the literature (Rahman, 2008; Damisa and Yohanna, 2007; Rahman and Alamu, 2003; Amali, 1989) Findings from a study financed by the United Nations Development Programme (UNDP) revealed that women make up some 60-80 percent of agricultural labour force in Nigeria (World Bank, 2003), depending on the region and they produce two-thirds of the food crops. Yet, in spite of these, widespread assumption that men – and not women - make the key farm management decisions has prevailed. (Ogunlela and Muktar, 2009). Women play significant involvement in household food security, and their activities contribute substantially to poverty alleviation. Consequently, the first pillar of food security is sustainable production of food (Odurukwe et.al., 2006). However, the population growth rate of Nigeria is getting increasingly higher than the sustainable level of food production in the country (Oritiz 2003), and as a result there is need to increase productivity of men and women farmers by encouraging the adoption of high yielding technologies suitable for the environment. In this study, gender is seen as the relationship between men and women farmers who make, according to their socioeconomic characteristics, adoption choices based on complex varietal selection criteria and maize varieties. This study therefore investigate gender differences in maize productivity using panel data collected from on-farm trials from 2012 to 2015 in South Guinea Savannah region of Nigeria. The specific objectives are to: (i) compare maize productivity by gender; (ii) elicit varietal preference by men and women; (iii) evaluate the determinants of the gender productivity differences. and (iv) determine the technical efficiency of the maize farms by gender.

MATERIALS AND METHODOLOGY

Sampling Technique and Description of Experimental Materials

The study was carried out in southern guinea savanna (SGS) of Nigeria. The sampling technique consists of three multi- stage stratified sampling during the first year of the project which continue to collect data for four (4) years i.e 2012 t0 2015. At the first stage, three states out of the states in the SGS were selected purposive. These are the states where the DTM on-Farm trials are being carried out through the project. The selected states were Kwara, Niger and Oyo. The second stage consists of random selection of locations/communities. Six locations of DTMA trials were proportionately selected according to the number of trials in each states (table 2). The locations selected were Ilorin 1, Ilorin 2, Ilorin 3. Mokwa, Lapai and Kishi. The third stage involves selection of farmers. Thirty farmers with equal number of female and male were selected in each of the locations for the survey. The total numbers of farmers is one hundred and eighty (180) with ninety (90) females and ninety (90) males.

RESULT AND DISCUSSION

Farm-related Characteristics of Male and Female Farmers

This section presents the characteristics of male and female farmers as related with their farming activities in the study area.

Table 1: **Farming-related Characteristics of Male and Female Farmers**

s/n		**Male**		**Female**	
	Variables	**Frequency**	**%**	**Frequency**	**%**
	Status of farming Major Minor	 66 34	 73 27	 68 32	 75 25
	Total	**90**	**100**	**90**	**100**

	Land ownership Inherited Rented Borrowed Government owned Gift	 57 12 5 13 3	 63.3 13.3 5..6 14.6 3.3	 52 30 8 0 0	 58. 33.2 8.8 0.0 0.0
	Total	**90**	**100**	**90**	**100**
	Availability of sufficient labour Yes No	 57 33	 63.3 36.6	 75 15	 83.3 16.7
	Total	**90**	**100**	**90**	**100**
	Types of labour available Family Hired Communal Family and hired Family and communal	 58 29 3 0 0	 64.4 32.2 2.7 0.0 0.0	 41 26 7 13 3	 45.8 29.2 7.8 14.4 4.2
	Total	**90**	**100**	**90**	**100**
	Hiring service Yes No	 68 22	 75.6 24.4	 60 39	 66.7 33.3
	Total	**90**	**100**	**90**	**100**

Source: Data analysis, 2016

The table indicates that both male and female farmers posited farming as the major source of income. This is evident as 67.1% and 75% of male and female farmers respectively are predominantly farmers. Among the farmers, the most popular means of acquiring land is through inheritance (51% for male, 42% for female). The implication of this could be fragmentation of land overtime with its resultant effect on productivity of the farmers. However, few of the male farmers got the government owned land for farming (14.6%).No female farmer got land from government. This means would enhance male productivity since it acts as an incentive for the farmers. Most of the famers have access to sufficient labour for their farming activities. This is evident as about 65% of male farmers and about 84% of female farmers have adequate numbers of labour they need for their farming activities. For the type of labour available to the farmers, both male and female groups rely predominantly on family labour for their farming activities. This would enhance the productivity of the farmers, *ceteris paribus*. Some of the male and female farmers have access to tractor hiring service with higher number of male. Although comes with its cost implication, this would enhance increased productivity among the male farmers.

Seed-related Characteristics of Male and Female Farmers

This section deals with farmers' perception on their accessibility to improved seeds, its source, their colour preference and the end use of their maize output.

s/n		Male		Female	
	Variables	**Frequency**	**%**	**Frequency**	**%**
	Access improved seeds Yes No	 48 42	 53 47	 34 56	 37.8 62.2
	Total	**90**	**100**	**90**	**100**
	Sources of seed ADP ADP and input sellers Input sellers Owned	 11 3 24 52	 12.2 3.3 26.7 57.7	 3 0 23 64	 3.3 0.0 26.0 70.7
	Total	**90**	**100**	**90**	**100**
	Do you have colour preference? Yes No	 82 8	 91.0 9.0	 90 0	 100 0.0
	Total	**90**	**100**	**90**	**100**

	Colour preferred Yellow White None	 53 29 8	 59.1 32.0 8.9	 75 15 0	 83.4 16.6 0.0
	Total	**90**	**100**	**90**	**100**
	End use of maize Fresh Ogi/akamu/tuwo For sale Fresh and ogi/akamu/tuwo Fresh and for sale Ogi/akamu/tuwo and for sale Fresh,ogi/akamu/tuwo and for sale	 13 12 30 0 8 20 7	 3.7 14.6 36.6 0 9.8 29.3 6.1	 3 37 18 13 0 12 9	 4.2 37.5 25 4.2 0 16.7 12.5
	Total	**90**	**100**	**90**	**100**

Source: Data analysis, 2016

The result shows that most of the farmers (57.3% male and 62.5% female) do not have access to improved seedlings. The implication of this is that increased food production might just be a mirage, except urgently handled. Almost 58% of male farmers and 71% of female farmers have the seed stored from previous harvest as their source of seed. This would determine the extent of their productivity since most of the seeds could be local varieties. Most of the male farmers (89%) and all the female farmers have preference for the colour of maize. The colour of maize preferred by majority of the farmers is yellow (59% male and 83.4% female).

COMPARING CROP FARMERS PRODUCTIVITY USING PROPENSITY SCORE MATCHING (PSM)

The Average Productivity Index computed revealed that male farmers are more productive than female farmers (table 3). This section compare the productivity more formally using the propensity score matching (PSM) technique which involves the calculation of the propensity scores to create a more comparable counterfactual (Boone et al., 2013).The study found male farmers to be more productive than female farmers.

Table 3: Result of Propensity Score Matching of male and female productivity

Variables	Treatment Effect	Yield	Coefficient	Std error	Z-Value
Male	**ATT** **ATE**	**1,734**	**447.214***** **387.463*****	**53.559** **83.446**	**8.35** **4.64**
Female	**ATT** **ATE**	**836**	**297.583***** **326.378*****	**59.876** **107.656**	**4.67** **3.03**

Source: Data Analysis 2016
*Notes: *** - Significant at 1%; **-Significant at 5%; *-Significant at 10%*

Factors Determining productivity of Male and Female Farmers

The factors determining the productivity of male and female farmers are presented in table 4. Among the factors determining the yield, gender is significant at 1% level of significance. This is predicted by apriori because the average yield of male (1,734 kg) is significantly higher than the female counterpart (836kg).

Table 4: Determinants of productivity of male and female farmers

Independent variables			T	Sig.
	B	*Std. Error*		
(Constant)	2351.644	672.620	3.496	.001

Gender	-492.771***	164.838	-2.989	.003
Age	-20.471	14.300	-1.431	.155
Marital status	-156.010	207.819	-.751	.454
Year of farming experience	28.243	15.189	1.859	.065
Year of schooling	-19.363	14.672	-1.320	.189
Status of farming	-232.837	181.714	-1.281	.202
Monthly income from other sources	-.026***	.005	-5.495	.000
Year of cooperative membership	52.038	31.642	1.645	.102
Labour availability	21.885	18.630	1.175	.242
Access to improved seeds	35.240	180.990	.195	.846
Farm size	260.180***	36.872	7.056	.000

Source: Data Analysis, 2016

*Notes: *** - Significant at 1%; **-Significant at 5%; *-Significant at 10%*

The monthly income from other sources also has a significant effect on the yield of farmers, at 1% with a negative sign. This implies that the higher the income from other sources, the farmers' interest in farming reduces, with its attendant effect on the output. The coefficient of farm size is also very significant at 1% in positively determining the yield of farmers.

Table 5: Stochastic Production Frontier of Male Farmers

	Coefficient	Standard-error	t-ratio
Constant	0.1315	0.8182	0.1607
Land	0.2179	0.2867	7.6010***
Agrochemical	0.3884	0.5731	6.7760***
Labour	0.1692	0.8389	2.0171**
Fertilizer	0.1070	0.3177	0.3370
Inefficiency			
Constant	-0.1780	0.1739	-0.1023
Age	-0.8917	0.7672	-3.162***
Marital status	0.5881	0.5619	0.1046
Years of experience	0.9784	0.8225	2.1892**
Education	0.3970	0.3146	0.1262
Farmers' group	0.2648	0.3252	8.1421***
sigma-squared	0.1029	0.8921	0.1153
gamma	0.9914	0.7949	0.1247

Source: Data Analysis, 2016

*Notes: *** - Significant at 1%; **-Significant at 5%; *-Significant at 10%*

The maximum-likelihood estimates of the parameters in the stochastic production frontier model and those in the technical inefficiency effect model for male farmers are presented in Table 5. The results obtained indicate that technical inefficiency effects are significant for the male farmers with σ2 being significantly different from zero. Hence, indicating that Cobb-Douglas production function is a representative model and that the majority of error variation is due to the inefficiency error ui (and not due to the random error vi). The significance and magnitude of the estimate for the variance parameter, γ (0.994), also supported the results from the likelihood-ratio tests. The maximum-likelihood estimate for the parameter γ is 0.9308. This indicates that 93% of the variation in output is due to their technical inefficiency. Land, agrochemical and labour were statistically significant in determining efficiency. Since Cobb Douglas type production function was used, the estimator directly represents elasticity of independent variables. The estimated coefficients of the explanatory variables in the model for technical inefficiency effects are of interest and have important implications as shown in Table 4. Given the specifications of the preferred model with inefficiency effect, it is noted that the age, education and membership of farmers' group are statistically significant variable influencing technical inefficiency. The mean efficiency for male farmers is 0.61817.

Table 6: Stochastic Production Frontier of Female Farmers

	Coefficient	Standard-error	t-ratio
Constant	0.1108	0.7586	1.4600

Land	0.1925	0.1340	1.4370
Agrochemical	0.3318	0.2131	5.5600***
Labour	0.3268	0.1985	2.1646**
Fertilizer	0.1108	0.3257	0.3401
Inefficiency			
Constant	0.6874	0.7883	8.7200
Age	0.5923	0.1383	4.2810***
Marital status	0.3953	0.3334	2.1185**
Experience	-0.1085	0.1785	-0.6079
Education	-0.7678	0.5927	-0.1295
Farmers' group	-0.4560	0.5374	4.4850***
sigma-squared	0.1106	0.2541	0.4354
gamma	0.2222	0.2266	0.9998

Source: Data Analysis, 2016

*Notes: *** - Significant at 1%; **-Significant at 5%; *-Significant at 10%*

The maximum-likelihood estimates of the parameters in the stochastic production frontier model and those in the technical inefficiency effect model are for female farmers are presented in Table 6. The results obtained indicate that technical inefficiency effects are significant for the female farmers with σ2 being significantly different from zero. Hence, indicating that Cobb-Douglas production function is a representative model and that the majority of error variation is due to the inefficiency error ui (and not due to the random error vi). The significance and magnitude of the estimate for the variance parameter, γ (0.222), also supported the results from the likelihood-ratio tests. The maximum-likelihood estimate for the parameter γ is 0.1672. This indicates that 16% of the variation in output is due to their technical inefficiency. Agrochemical and labour were statistically significant in determining efficiency. Since Cobb Douglas type production function was used, the estimator directly represents elasticity of independent variables. From the specifications of the preferred model with inefficiency effect, it is noted that the age, marital status and membership of farmers' group are statistically significant variable influencing technical inefficiency. The mean efficiency for male farmers is 0.5791.

Table 7: Stochastic Production Frontier of Pooled Data

	Coefficient	standard-error	t-ratio
Constant	0.1087	0.2564	4.2410
Land	0.5037	0.1004	5.0140***
Agrochemical	0.7970	0.2406	3.3121***
labour	0.4021	0.1584	0.2537
Fertilizer	0.5285	0.1165	0.4535
Inefficiency			
Constant	-0.4149	0.7169	-0.5787

Age	-0.1508	0.1203	1.2530*
Marital status	-0.1965	0.2051	9.5800***
Farming experience	0.2765	0.1069	2.5850**
Education	-0.7517	0.1361	5.5220***
Farmers' group	0.1194	0.1786	6.6890***
Sex	0.2924	0.2393	2.2250**
sigma-squared	0.6794	0.7119	0.9543
gamma	0.9983	0.4801	0.2078

Source: Data Analysis, 2016

*Notes: *** - Significant at 1%; **-Significant at 5%; *-Significant at 10%*

Table 7 presents the result of the pooled data. The table revealed that farm size and agrochemical were statistically significant in determining the farmers' efficiency. The inefficiency model also indicates that marital status, farming experience, number of years spent in school, membership of farmers' group and sex are statistically significant in determining the efficiency of farmers in the study areas. The mean efficiency for the pooled data is 0.4460.

Conclusion

It is evident that women farmers can be instruments of effective adoption and it is possible to conceive an integrated innovation in which women interest will be considered. The study therefore concludes that women despite their decision making ability incapacitated, can still be involved at any stage of innovation's conception. Considering the complex nature of agricultural research demands, coordinated effort is needed among all actors in order to ensure that appropriate technology is promoted.

CONCLUSION AND RECOMMENDATION

The results from econometric analysis show that productivity was significantly lower for female-headed households than their male counterparts. This is attributable to a larger farm size and higher inputs used by the male crop farmers. However the female farmers are technically more efficient given the inputs used. Based on this study, it is recommended that since farm inputs will help to bring about increase productivity, future policies should aimed at increasing small scale farmers especially women in agriculture access to agricultural inputs at an affordable price. Also, given the irreversible trend in the decline of agricultural land, one feasible way to ensure food security is to increase farm land productivity. The use of more land augmenting inputs example fertilizers and irrigation facilities could be a solution. The study therefore recommends that more agricultural efforts should be devoted to the dissemination of valuable information to rural farmers especially women in agriculture. Also government and development agencies should develop a strategy of rural social mobilization and public enlightenment for women in agriculture. Such strategy should include access to credits, land and extension services.

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