European Journal of Business and Management www.iiste.org
ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online)
Vol.9, No.5, 2017

Gender Differentials and Adoption of Drought Tolerant Maize Varieties among Farmers in Northern Nigeria

Gaya, H. I.[1] Tegbaru, A.[1] Bamire, A. S.[2] Abdoulaye T.[1] Kehinde, A. D.[2]
1.International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria
2.Obafemi Awolowo University, Ile-Ife, Nigeria

Abstract
This study examined gender differences in farmer's adoption of drought tolerant maize (DTM) varieties in Northern Nigeria. Specifically, it described the socio-economic characteristics of the farmers by gender; determined their rate of adoption of the DTM varieties; and analysed the factors affecting the rate of adoption of the varieties. The study was conducted in seven: Borno, Bauchi, Kano, Kaduna, Niger, Zamfara, and Kwara states of Nigeria. A multistage sampling procedure was used to select 946 respondents, comprising 626 males and 320 females. Data were collected with the use of a survey questionnaire that contained questions on respondent's socio- economic characteristics such as age, years of schooling, household size, farm size, access to credit, level of awareness and adoption of DTM varieties and extension contact, among others. Data were analyzed using descriptive statistics and probit regression model. The results for the entire respondents showed average values of 46 years for age, seven years for year of schooling, 11 for household size, 6.93 for farm size and 5.7 ha for land area allocated to maize, with a significant difference ($p<0.05$) between male and female farmers for each of the variables. The adoption rate of DTM was 56.3% on the average in the entire sample with a significant difference ($p<0.05$) between male (61.8%) and female farmers (53.5%). The determinants of adoption of DTM varieties for both male and female farmers were access to credit, participation in field days, household size, fertilizer application, source of seeds and level of awareness of the variety, specific to male farmers was land area allocated to maize and number of livestock while source of information about the DTM variety was specific to female famers. It was concluded that policy strategies aimed at improving the uptake of DTM varieties must consider equality in male and female farmers' access to basic resources, such as credit, land, labour, and participation in different meetings.
Keywords: Gender, Drought tolerant, Maize varieties, Adoption, Nigeria.

1. Introduction

Maize (*Zea mays* L., Poaceae) is the most important cereal in the world after wheat and rice, and perhaps the most important food and industrial crop widely consumed as a staple food by urban and poor rural households in Nigeria, making up to 80% of their total crop value (Jayne *et al*., 2007; Onuk *et al*., 2010; FAOSTAT, 2015). It is also processed industrially for flour, animal feeds, biscuits, beverages and beer and in these forms is consumed widely across the country. These have an added potential for addressing the food insecurity challenges posed by the increasing levels of population, urbanization, increased land-use intensity, as well as poverty and hunger across the country. Hence, any credible strategy for meeting the food scarcity challenges facing the country must have a strong maize production component.

Despite the importance of maize, its production in Nigeria has been insufficient to meet the needs of people, industry, and livestock. The domestic demand for maize stands at 3.5 million metric tonnes, while the supply is about 2 million metric tons (FAOSTAT, 2015). This is because most of the maize is produced under rain-fed conditions and irrigation is used only in few areas (Muzari *et al*., 2012). According to Bamire *et al*. (2010), the major constraints to maize production in Nigeria are unstable weather conditions that manifest as droughts, declining soil fertility, Striga infestation, lack of access to and high cost of improved production inputs such as seeds, fertilizer application and farmer friendly credits. Others are weak extension services, poor market infrastructure and linkages.

Drought is the most important environmental factor constraining maize production. Recurrently, Nigeria experiences drought which tends to be severe, especially in the northern part of the country at the beginning and towards the end of the rainy season, resulting in general water stress and crop failures (Nyong *et al*., 2007). Out of the 5.218 million ha under maize production in 2012, an estimated 1.85 million ha is prone to severe droughts or damaging annual dry spells (Ayinde *et al*., 2013). Dry spells are becoming the norm and are worsening over the years, and in many cases complicated by floods, disease, and heat stress. This accounts for annual yield losses of 25% of potential maize yield (CIMMYT, 2013).

To address the problem of drought, The International Centre for Maize and Wheat Improvement Centre (CIMMYT) and International Institute of Tropical Agriculture (IITA) in collaboration with national agricultural research institutes (NARIs), initiated a research project on drought tolerant maize for Africa (DTMA). The project has been developing new hybrids and varieties that are resistant to drought. The varieties can produce about 20 to 50% higher yields during drought periods. Numerous DTM varieties were released in Nigeria through the DTMA project between 2007 and 2013, but there still exists a supply-demand gap (Babatunde *et al*., 2008).

DTM varieties enhance notable improvements in maize production. However, their adoption and degree of use after adoption by farmers remains low, even in the drought-prone parts of the country (Tambo and Abdoulaye, 2013). The low adoption rate and in some cases, discontinued use of new varieties for maize production could be traced to a complex set of socio-economic factors, such as the education of the farmer, age, and especially gender issues (Alene *et al*., 2009; Kijima *et al*., 2011).

The concept of gender has often been misinterpreted to mean the promotion of women only. According to Imoh and Nwachukwu (2009) and Oladeebo (2012), gender is defined as the relationship between men and women in terms of their social roles, access to resources, and division of labor, among others. Thus, gender in agricultural technology adoption means the different roles men and women play in the adoption of specific improved technologies (Bonabana-Wabbi, 2002). Evidence shows that there are variations in the rate and degree of adoption of improved technologies by male and females, if the technologies are introduced at the same time. This has been associated with some socio-cultural values and norms in which men have better access and control over resources than women. In that context, a new technology will not be equally adopted by men and women (Mesfin, 2005; Omonona *et al.,* 2006; Mignouna *et al*., 2011; Amare *et al*., 2012). In view of the important contribution of both men and women to household food security, income and poverty reduction, understanding the gender variations in the adoption of DTM varieties becomes imperative.

This paper documents the gender differentials in the adoption of DTM varieties in the Northern part of Nigeria. Specifically, it describes the socio-economic characteristics of maize farmers in the area by gender; estimates their adoption rate of DTM varieties; and determines the factors that influence the rate of adoption of the varieties.

2. Methodology

This section describes the survey locations, the sampling procedure and sample size, data collection methods as well as the techniques of data analysis.

2.1 Study area

The study was conducted in seven states (Borno, Bauchi, Kano, Kaduna, Niger, Zamfara, and Kwara States) in Northern Nigeria. These states cut across different agro-ecological zones like the Northern Guinea Savannah (NGS), Sudan Savannah and Southern Guinea Savannah (SGS). In the recent times, the NGS has been identified as the ecology with the highest maize yield potential in West and Central Africa (Bamire *et al*., 2010; Badu-Apraku *et al*., 2014).

2.2 Sampling procedure and sample size

A multi-stage sampling technique was used to select respondents for the study. The first stage involved a purposive selection of the seven states where DTM varieties had been disseminated. The second stage involved purposive sampling to select three local government areas (LGAs) where DTM varieties were promoted among the farmers. In the third stage, 10 villages were selected from each LGA based on a systematic probability proportionate to size approach. In each village, simple random sampling technique was used to select between eight and ten respondents to give a total of 946 respondents, consisting of 626 male farmers and 320 female farmers. Data were collected on farmers' socio-economic characteristics such as age, education, gender, household and farm size, level of awareness and on cultivation of DTM varieties, among others.

2.3 Analytical techniques

Data were analysed with the use of descriptive statistics and Probit regression technique.

2.3.1 Descriptive statistics

Descriptive statistics was used to describe gender differences among study variables. It involved the computation of means, standard deviation, frequency counts and percentages.

2.3.2 Probit regression model

Probit regression was used to determine the factors influencing the adoption of DTM varieties for the entire sample and by gender. Probit is a binary choice model that can only assume two values of 1 or zero and tries to explain the probability that a farmer will choose an improved variety over a traditional variety based on some factors (Akudugu *et al*., 2012). For example, a farmer may choose to adopt the DTM variety or otherwise. This decision is a function of a set of socio-economic factors that may likely affect the probability that male and female farmers will adopt the technology or not. In this study, the dependent variable is the probability of adoption of DTM varieties by the farmers.

The estimated Probit model is specified as follows:

$Y_i = \beta_0 + \beta_1 AGEHHED + \beta_2 FFEDU + \beta_3 FAMSIZE + \beta_4 MAZAREA + \beta_5 ACECRED + \beta_6 FEILDDAY +$

β_7HHSIZE + β_8SOUROFINFOR + β_9LIVESTCK + β_{10}FERTILIZ + β_{11}IRRIGATION + β_{12}SELFSUFFICIEN + β_{13}SOURCSEED + β_{14}AWAR + e_i
Where,
Y_i is the dependent variable, the probability of adoption of DTM varieties (Dummy: Adopt, 1; Non-adoption, 0)
The independent variables are:
AGEHHED is age of the farmers (years)
FFEDU is years of schooling (years)
FAMSIZE is farm size (ha)
MAZAREA is the land area allocated to maize production (ha)
ACECRED is access to credit (1= Access, 0= Non access)
FEIDDAY is participation in field days (1= Yes, 0= No)
HHSIZE is farm household size (#)
SOUROFINFOR is source of information (1= Govt. agric. ext. service, 2= Private. ext. service)
LIVESTCK is number of livestock (#)
FERTILIZ is fertilizer application (1= Yes, 0= No)
IRRIGATION is irrigation application (1= Yes, 0= No)
SELF SUFFICIEN is self-sufficiency in maize production (1= Yes, 0= No)
SOUCESED is source of seeds (dummy variable 0= Informal source, 1= Formal source)
AWAR is awareness of DTM varieties (1= Yes, 0= No)
e_i is random error term.

3. Discussion

3.1 Socio-economic characteristics of maize farmers

The socio-economic characteristics of farm households by gender are shown in Table 1. The average age of respondents in the entire sample was 45.8±13.52 years with a significant difference ($p<0.05$) between the mean age of male (47±13 years) and female (45 ±14 years) farmers. This suggests that male maize farmers were relatively older than their female counterparts. Education gives farmers the ability to obtain and process information relevant to improved technology. The average number of years of schooling was 7.2 ±4.3 years for the entire sample, with a significant difference ($p<0.01$) between that of male farmers (7.9 ±4.5) years and female farmers (6.7±4.2). The mean farm size was 6.93 ±4.3 ha for the entire sample of farmers. There was however a significant difference ($p<0.01$) between the male (8.66±5.9) ha and the female (3.0±1.0) ha farmers. This suggests that male farmers have larger farms than the female and this might be attributed to the socio-cultural norms that restrict access to land for women in the study area. The average land area allocated to DTM varieties was 5.71±2.36 ha for the entire sample, with a significant difference ($p<0.01$) between male farmers (5.85±2.76) ha and female farmers (5.3±1.6) ha. This may further suggest that males have better control and access over resources, particularly land, and therefore likely to try new innovations such as planting DTM varieties. About 36% of the entire sample had access to credit, with variations between male farmers (38.2%) and the females (31.7%). Also, about 69 percent of the entire sample of farmers participated in field days, majority (74%) of who were male while only (8.8%) were female.

The average household size for the entire sample was about 11±7.0 persons per household, with a significant difference ($p<0.01$) between male headed households (13±8) and female headed households (10±6). This shows that for their maize production operations, male-headed households have a larger size with access to more family labour than female-headed households. The source of seed depicts the type of varieties that is to be used in a particular planting season. Only 18.3% of the entire sample had access to formal sources of seed, with a relatively larger proportion of male (26.6%) than the female (14.1%). About 56% of the entire sample received information about DTM from government agricultural extension services, 58% of whom were male farmers and 55% female farmers. This suggests that both male and female farmers receive information about DTM varieties from the same source. The possession of livestock is an indicator of a farmer's wealth. About 74.3% of the entire sample own livestock, 78.9% of which are owned by male farmers and 65.2% by female farmers. Only 13.9% of the farmers irrigated their maize farms, comprising 8.3% male and 5.6% female farmers while about 79.9% of the entire respondents were self-sufficient in maize production, comprising 71.1% of the male and 8.8% of females.

The level of awareness of any technology stimulates its adoption. On the average, about 35% of the entire sample was aware of the DTM varieties, with relatively larger proportion of male farmers (59.2%) than female farmers (22.2%). This may suggest that more males will likely adopt DTM varieties.

Table 1: Socio-economic characteristics of maize farmers by gender

Variables	Entire Sample (n=946)	Male (n=626)	Female (n=320)	T-test
Age (years)	45.79(13.52)	47(12.5)	45.2(14.3)	2.04**
Years of schooling	7.16(4.33)	7.9(4.5)	6.8(4.2)	4.07***
Household size (#)	11.3(6.84)	13.0(7.7)	10.4(6.2)	5.57***
Farm size (ha)	6.93(4.24)	8.7(5.9)	3.0(1.0)	10.8***
Land allocated to DTM (ha)	5.71(2.36)	5.9(2.8)	5.3(1.6)	3.14***
Access to credit (%)	36	38.2	31.7	
Participation in field days (%)	69	74.6	8.8	
Source of information (%)	56.4	58.0	55.1	
Private Agric. Ext. Services	43.9	42.0	44.9	
Govt. Agric. Ext. Services	56.1	58.0	55.1	
Own livestock (%)	74.3	78.9	65.2	
Applied fertilizer (%)	80.1	80.3	80.4	
Applied irrigation (%)	13.9	18.1	5.6	
Self-sufficiency (%)	74.1	79.9	71.1	
Formal source of seeds (%)	18.3	26.6	14.1	
Awareness (%)	34.6	59.2	22.0	
Rate of adoption of DTM (%)	56.3	61.8	53.5	

Note: Figures in parentheses ( ) are standard deviations; ***, **Significant at 1% 5% respectively.

3.2 Adoption of DTM varieties

The rate of adoption of DTM varieties for the entire sample of farmers and by gender is shown in Figure 1. The adoption rate by the entire sample was 56.3%, with males having a relatively larger proportion (61.8%) and females (53.5%). This could be ascribed to freedom of male mobility in participating in field days and other technology demonstrations as compared to the females, which invariably give them more access to information on new technologies for their adoption (Bamire *et al*., 2012; Etwire *et al*., 2013).

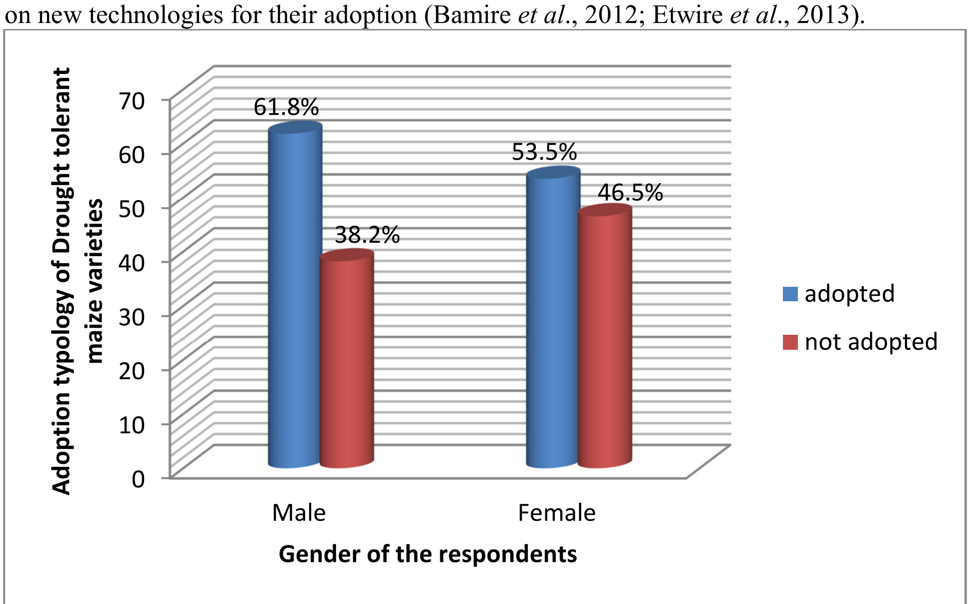

Figure 1: Adoption of DTM varieties

3.3. Factors influencing farmers' adoption of DTM varieties

The factors driving farmers' adoption of DTM varieties among the entire sample and by gender are shown in Table 2.

Table 2: Factors influencing the adoption of DTM varieties by gender

Variables	All respondents (n=946)	Gender	
		Males (n=626)	Females (n=320)
Age	-0.050(-1.49)	-0.013(-1.24)	0.007(0.16)
Education	1.430(0.15)	0.027(1.06)	0.147(1.02)
Farm size	-0.0011(-0.43)	0.026(1.21)	-0.068(-0.80)
Land allocated to maize production	0.052(2.61)***	0.222(3.00)***	0.035(1.55)
Access to credit	-0.034(-0.70)	-0.203(-1.73)*	0.119(1.95)*
Field days participation	0.224(2.97)***	0.213(1.98)**	0.606(4.34)***
Household size	-0.020(-2.37)**	-0.035(-1.85)*	-0.011(-1.74)*
Source of information	-0.325(-3.24)***	0.091(0.38)	-0.522(-4.40)***
Livestock	-0.355(-3.16)***	-0.486(-2.22)**	-0.205(-1.45)
Fertilizer application	0.861(6.97)***	0.454(1.73)*	0.739(4.77)***
Irrigation	0.02(0.16)	-0.066(-0.13)	0.123(0.83)
Self-sufficiency	-0.239(-2.17)**	-0.460(-1.84)*	-0.117(-0.90)
Source of seeds	1.266(7.45)***	0.846(2.74)***	1.337(6.09)***
Awareness	0.359(3.03)***	1.502(6.20)***	-0.456(-2.09)**
Constant	0.894(2.20)**	2.019(2.07)**	2.147(3.68)***
Chi-square	302.99	212.42	154.84
Log likelihood	-496.016	-106.002	-349.944
Pro>chi2	0.000	0.000	0.000

*** Significant at 1%, ** Significant at 5%, * Significant at 10%. Figures in parentheses ( ) are t-values.

From Table 2, land allocated to maize production, participation in field days, household size, sources of information on maize seed, livestock owned, fertilizer application, self-sufficiency in maize production, source of seed and level of awareness significantly influenced the adoption of DTM varieties in the entire sample. However, the coefficients of land allocated to maize production, participation in field days attended, access to fertilizer, source of seed and level of awareness of DTM had positive signs. This implies that for every unit increase in any of these variables, the rate of adoption increases by the magnitude of their coefficients; 0.050 units for land allocated to maize production, participation in field days (0.224), fertilizer application (0.861), source of seed (1.266) and level of awareness of DTM (0.359) units (Ayinde *et al.*, 2013). Similarly, the coefficients of household size, sources of information on maize seed, livestock owned, and self-sufficiency in maize production had negative signs. This implies that for every unit increase in any of these variables, there is a reduction in the rate of adoption of DTM varieties by the magnitude of their coefficients; 0.020, 0.325, 0.355, and 0.239 units for household size, sources of information on maize seed, livestock owned, and self-sufficiency in maize production respectively.

A gender analysis of the factors driving the adoption of DTM varieties however showed some variations. For male farmers, the coefficients of land area allocated to maize production, access to credit, participation in field days, household size, number of livestock owned, fertilizer application, source of seed and level of awareness significantly influenced the adoption of DTM varieties among male farmers at different levels of probability (Akudugu *et al*., 2012; Amare *et al*., 2012). The coefficients of land allocated to maize production, participation in field days, source of seed and level of awareness had positive signs, implying that for every unit increase in any of these variables, the rate of adoption of DTM varieties increased by the magnitude of their coefficients; 0.222, 0.213, 0.846 and 1.502 units, respectively. Also, the negative coefficients of access to credit, household size, number of livestock owned, and fertilizer application imply that these variables reduce the rate of adoption by the magnitude of their coefficients; 0.203, 0.035, 0.486, 0.460 units respectively.

On the other hand, access to credit, participation in field days, household size, source of information on DTM varieties, fertilizer application, source of seeds, and level of awareness significantly influenced the adoption of DTM varieties among female farmers. The coefficients of four of the variables; access to credit, participation in field days, fertilizer application and source of seed had positive signs, while the coefficients of household size, source of information about the variety and level of awareness had negative signs. The positive signs suggest a positive influence on adoption of DTM varieties. A unit increase in access to credit, participation in field days, fertilizer application, and source of seeds increased the rate of adoption of DTM varieties by 0.119, 0.606, 0.739 and 1.337 units, respectively. Similarly, the negative signs of coefficients show a negative influence on adoption of DTM varieties, such that for every unit increase in household size, source of information and level of awareness, there is a reduction in the rate of adoption of DTM varieties by 0.011, 0.522, and 0.456 units respectively. This shows that while access to credit, participation in field days, household size, fertilizer application, source of seed, and level of awareness were common factors that drive the adoption of DTM varieties for both male and female farmers, land allocated to maize production, livestock owned, and self-sufficiency were specific to male farmers, while only source of information was specific to females (Bamire et al., 2010; Akudugu et al., 2012). This suggests that while strategies targeted at promoting male farmers adoption of DTM varieties should consider land allocated to maize production, livestock owned, and self-sufficiency, increasing female uptake of DTM varieties should focus on providing information about the varieties.

4. Conclusion

Maize is grown by a majority of farming households in Northern Nigeria with gender variations in the socio-economic characteristics of both male and female farmers and their level of awareness and adoption of DTM varieties. For example, male farmers were relatively older than their female counterparts, with significant differences between their years of schooling and farm sizes. Male farmers have larger farms than the female as a result of socio-cultural norms that attribute the control and access to land to men. The significant difference between male and female farmers' farm size gives male farmers opportunity to better try new innovations such as planting DTM varieties (Abdoulaye *et al*., 2012). Though both male and female farmers receive information about DTM varieties from the same source - government extension services, more males than females sourced for information.

The level of awareness of DTM varieties by maize farmers in Northern Nigeria is low, with males having a relatively larger proportion than the females. Consequently, more males (61.8%) adopted the variety than females (53.5%). This implies that DTM varieties should further be promoted in the study area, particularly among female farmers to enhance their adoption. The factors that significantly influenced the adoption of DTM varieties in the study area are land allocated to maize production, participation in field days, household size, sources of information on maize seed, livestock owned, fertilizer application, self-sufficiency in maize production, source of seed and level of awareness. However, while access to credit, participation in field days, household size, fertilizer application, source of seed, and level of awareness were common factors that drive the adoption of DTM for both male and female farmers, land allocated to maize production, livestock owned, and self-sufficiency were specific to male farmers, while only source of information was specific to females (Bamire *et al*., 2012; Abdoulaye and Anyebe, 2013). This suggests that while strategies targeted at promoting the adoption of DTM varieties among male farmers should consider land allocated to maize production, livestock owned, and self-sufficiency, increasing female uptake of DTM varieties should focus on providing information about the varieties. This could be made possible through intensive enlightenment programmes by effective and efficient extension services during field demonstrations and farmer field days. Government should also ensure gender equality in the access to basic resources such as credit, land, labor, and participation in different meetings among farmers in Northern Nigeria.

References

Abdoulaye, T., Bamire, A. S., Wiredu, A. N., Baco, M. N. and M. Fofana (2012). Project community surveys, characterization of maize-producing communities in Benin, Ghana, Mali and Nigeria: West Africa Regional Synthesis Report. Drought Tolerant Maize for Africa (DTMA), 18p.

Abdoulaye, T. and O. Anyebe (2013). Promoting the use of drought tolerant maize in Nigeria. *R & D Review* 10: 22–3, ISSN 2071-3681.

Akudugu, M., Guo, E., Dadzie, S. (2012). Adoption of modern agricultural production technologies by farm households in Ghana: What factors Influence their decisions? *Journal of Biology, Agriculture and Healthcare* 2(3):12-20.

Alene A.D, Menkir A, Ajala SO, Badu-Apraku B, Olanrewaju A.S., Manyong V.M., Ndiaye A. (2009). The economic and poverty impacts of maize research in West and Central Africa. *Agr Econ* 40: 535–550

Amare, M., Asfaw, S., and Shiferaw, B. (2012). Welfare impacts of maize–pigeon pea intensification in Tanzania. *Agricultural Economics, 1,* 1-17. http://dx.doi.org/10.1111/j.1574 0862.2011.00563.x.

Ayinde, O.E, Abduolaye T., Olaoye, G., J.A. Akangbe (2013). Gender and Innovation in Agriculture: A Case Study of Farmers' Varietal Preference of Drought Tolerant Maize in Southern Guinea Savannah Region of Nigeria. *Albanian J. Agric. Sci.* 12(4): 617-625.

Babatunde, R.O., S.B. Fakayode and A.A. Obafemi (2008). Fadama maize production in Nigeria: Casa study from Kwara State. *Res. J. Agric. Biol. Sci*., 4: 340-345**.**

Badu-Apraku, B., R. A. Asuboah, B. Fakorede and B. Asafo-Adjei (2014). Strategies for sustainable maize seed production in West and Central Africa. IITA, Nigeria. 140 pp.

Bamire, A. S., T. Abdoulaye, D. Sanogo and A. Langyintuo (2010). Characterization of maize producing households in the dry savanna of Nigeria. Country Report – Nigeria, IITA, Ibadan, Nigeria, 46pp.

Bamire, A. S., Abdoulaye, T., P. Amaza, A. Tegbaru, A. D. Alene and A. Y. Kamara (2010). Impact of promoting sustainable agriculture in Borno (PROSAB) program on adoption of improved crop varieties in Borno State of Nigeria, *Journal of Food, Agriculture & Environment* Vol.8 (3&4): 391 - 398.

Bamire, A.S., Abdoulaye, T. and D. Sanogo (2012). "Determinants of improved maize adoption in Nigeria: Are they the same for poor and well endowed households?" *Ife Journal of Agriculture,* Vol. 25: 83-100.

Bonabana-Wabbi, J. (2002). Assessing factors affecting adoption of agricultural technologies: The case of integrated pest management (IPM) in Kumi District, Msc. Thesis, Eastern Uganda

CIMMYT (2013) The Drought Tolerant Maize for Africa project. DTMA Brief, September http://dtma.cimmyt.org/index.php/about/background

FAOSTAT (2015). "Food and Agricultural Organisation of the United Nation". FAOSTAT Database available on line http://faostat fao.org/site/567/default.aspx (20.08.2015)

Imoh, A. N. and Nwachukwu, E. O. (2009). Analysis of Gender Participation in the Adoption of Improved Sweet Potato Varieties in Ishielu, Ebonyi State, Nigeria. *Nigeria Journal of Rural Sociology*, 9 (1):161-166.

Jayne, T. S., A. Chapoto and J. Govereh (2007). Grain Marketing Policy at the Crossroads: Challenges for Eastern and Southern Africa. Paper Presented at the FAO Workshop on Staple Food Trade and Market Policy Options for Promoting Development in Eastern and Southern Africa. Rome, Italy, March 1-2, 2007.

Kijima, Y., Otsuka, K., Sserunkuuma, D. (2011) An inquiry into constraints on a green revolution in sub-Saharan Africa: the case of NERICA rice in Uganda. *World Dev*. 39(1):77–86

Mesfin, A. (2005). "Analysis of factors Influencing Adoption of Triticale and its Impact: The Case Farta Wereda". Msc. Thesis (Unpublished) Presented to School of Graduate Studies of Alemaya University.

Mignouna, B., Manyong, M., Rusike, J., Mutabazi, S., & M. Senkondo (2011). Determinants of Adopting Imazapyr-Resistant Maize Technology and its Impact on Household Income in Western Kenya: *AgBioforum*, 14(3), 158-163.

Muzari, W. Gatsi, W and S. Muvhunzi, (2012). The Impacts of Technology Adoption on Smallholder Agricultural Productivity in Sub-Saharan Africa: A Review, *Journal of Sustainable Development*; 5 (8).

Ayinde, O.E, Abduolaye T., Olaoye, G., J.A. Akangbe (2013). Gender and Innovation in Agriculture: A Case Study of Farmers' Varietal Preference of Drought Tolerant Maize in Southern Guinea Savannah Region of Nigeria. Albanian J. Agric. Sci. 12(4): 617-625.

Nyong, A., Adesina, F. and E. Osman (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitig Adapt Strategies Glob Chang* 12:787–797

Etwire, M. , Abdoulaye, T. , Obeng-Antwi, K. , Bua , A. , Kanton, R. , Asumadu, H. , Abdulai, M. S. , Haruna, A. , J. Etwire (2013). "On-farm evaluation of maize varieties in the transitional and savannah zones of Ghana: determinants of farmer preferences". *Journal of Development and Agricultural Economics*, 5(6):255 – 262.

Oladeebo, J.O. (2012). Technical Efficiency and Rural Poverty among Farmers in Nigeria: A Gender Perspective. *Global Journal of Science Frontier Research Agriculture and Veterinary Sciences*, 12(8): 1 – 8.

Omonona, B., Oni, O., and O. Uwagboe (2006) "Adoption of improved Cassava varieties and its impact on Rural Farming Households in Edo State, Nigeria". *Journal of Agriculture and Food Information* 7(1): 40-45.

Onuk, E. G., Ogara, I. M., Yahaya, H. and N. Nannim (2010). Economic Analysis of Maize Production in Mangu Local Government Area of Plateau State, Nigeria. *PAT Journal*, 6 (1): 1-11

Tambo, J. A. and T. Abdoulaye (2013). Smallholder farmers' perceptions of and adaptations to climate change in the Nigerian savanna. *Reg Environ Change,* 13:375–388.