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Membership in association, gender and adoption of land-enhancing technologies among arable farmers in Ogun state, Nigeria

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Abstract. *This study investigated the effect of membership in farmers' association on adoption rate of land-enhancing technologies in Ogun State, Nigeria by gender. Specifically, it describes the socio-economic characteristics of the farmers by gender, identifies land-enhancing technologies adopted by farmers in the study area, determines the adoption rates of the technologies by gender, and determines the membership in farmers' association on the adoption and intensity of use of land-enhancing technologies by gender. Multistage sampling procedure was used to select 120 respondents for the study. The data were analysed using descriptive statistics and the Cragg's (double-hurdle) model. The results of the descriptive statistics, which are expressed by gender, reveal that the sampled population were majorly comprised of males (58%), than females (42%). The level of association membership was 54% for females and 35.29% for males, and only 33.82% of the respondents had contact with extension agents. The results also show that 17.65% of males and 10% of females did not adopt any technology. The results from the Cragg's double hurdle model show that extension contact significantly influenced the adoption of most of the technologies. It had a positive relationship with the adoption of all the technologies across both genders, except for organic manure whose adoption was negatively influenced. It is therefore recommended that relevant governments and stakeholders improve extension services, as well as consider farming associations as means of getting across to female famers in order to improve their adoption levels and productivity.*

Keywords: adoption rate, land-enhancing technologies, descriptive statistics, Cragg's model, extension services, productivity

Introduction

Arable crops are crops that are harvested within a planting season or within a year. They could be annual or biennial. Also, arable crops may be referred to as 'Temporary crops' or 'Food crops' (FAO, 2017). Arable farming is the major occupation of the residents of Ogun state, Nigeria. Arable crops extensively produced in the State include maize, cassava, yam, cocoyam, soybean, among others. These crops played a significant role in the increase of food production and the economy of the State. However, the productivity of these arable lands was greatly reduced. This is evident in the chasm that exist between the potential yields of the arable land under cultivation and the actual yield obtained. This could be attributed in part to non-use of land-enhancing technologies (Akinola et al., 2011; Fadipe et al., 2014). Consequently, quite a number of land enhancing technologies such as fertilizer application, organic manuring, liming, crop rotation, among others which have been proven to significantly increase productivity of arable farm lands have been introduced over the years (ICARDA, 2017). However, the adoption rate of these technologies is very low which has been ascribed to factors including gender, age, access to extension services, level of education and income, among others (Ajayi et al., 2007).

More important weight is attached the gender of the farm owner or manager (Doss and Morris, 2001; Muriithi et al., 2018). In Nigeria, there is a substantial degree of gender bias in terms of access to land, credit and labor resources, among others, which directly influence the adoption of agricultural technologies. Women have very unequal access to agricultural land and resources, even though they are the main cultivators (Kerr, 2017). In addition, agricultural practices are deeply characterized by traditional gender roles that build up on existing patriarchal social and cultural norms that limit women's empowerment (Ingawa, 1999; Mgbada, 2000, Rahman et al., 2004; Garcia and Wanner, 2017), even though women are at the forefront of meeting the challenge of low arable land productivity (Kabeer, 2014; Doss, 2015). This could be the major reason for the large gap between potential yield and actual yield in production of arable crops in Nigeria. It is obvious, therefore, that improving the access of females to land-enhancing technology would substantially increase the country's arable production.

Membership in association seems to be the best instrument to bring about such economic development of women. The access of females to land-enhancing technology could successfully be improved by encouraging women farmers to be members of farmers' association which targets to promote

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gender equality. Better still, women-only cooperatives may help overcome social and cultural constraints which might limit access of female farmers to land-enhancing technology.

Consequently, it is therefore important to know the effect of membership in association on adoption rates and intensity of adoption of these technologies by gender. Although many studies have been undertaken on the topic of adoption of land-enhancing technologies, and even a few on the topic of gender differentials in adoption rates of certain improved technologies, nonetheless, there still exists a dearth of information on the membership in association and gender perspective of the adoption of land-enhancing technologies. In order to address this, the following questions need to be answered: What are the socio-economic characteristics of the farmers in terms of gender? Which land-enhancing technologies have been adopted by farmers in the study area (Ogun State)? What are the adoption rates of these technologies in terms of gender? What is the effect of membership in association on rates of adoption and intensity of use of these land-enhancing technologies by gender?

Material and methods

Study area

Ogun State is located in the South Western part of Nigeria. It covers a total of 1 640 076 km^2 of land mass where over 60% are cultivable arable land, with an estimated population of about 3.391 million. The State is heterogeneous comprising the Egba, Yewa, Egun, Awori, Ijebu ethnic groups who speak different languages. The major occupation of residents of the state is farming. Arable crops such as maize, cassava, yam, cocoyam, soybean, etc. are extensively produced in the State. The physical environment (soil characteristic and climatic effects), the vegetation type and the availability of markets are all contributory factors that have facilitated the development of the agricultural sector in the State. The vegetation in the State covers the rain forest features in the coastal towns to derived savannah features in the northern part of the State. The rainfall pattern is bimodal in nature with peaks in July and September. Generally, the rain period occurs between March and October (IFERAR, 2009).

Sampling procedure

Multi-stage sampling procedure was employed in the study to randomly select the total number of 120 respondents. At the first stage, five local governments were purposively selected, one from each cardinal region of the State and the centre of the State based on the predominance of cassava farmers. At the second stage, two village communities were randomly chosen from each of the local governments, making 10 communities. Finally, twelve arable farmers were selected at the third stage using simple random technique, completing the total of 120 respondents. The questionnaires focused on obtaining information on economic and demographic characteristics of the farmers, their level of knowledge of land-enhancing technologies, the type of land-enhancing technologies they have employed on their farms, the degree of use of the applied land-enhancing technologies.

Analytical techniques

The data were analysed using descriptive and Cragg's (double-hurdle) model. Descriptive statistics was used to summarize the socio-economic characteristics of the respondents and land-enhancing technologies adopted by arable farmers in the area, as well as the rate of adoption of land-enhancing technologies among the farmers by gender.

The Cragg's model two-step estimation procedure: The Cragg's model was chosen for this study because it relaxes the restrictive assumption of the Tobit model that the factors influencing the discrete decision (adoption decision) and the continuous decision (intensity of use) as well as their effects are the same. Hence, in the Cragg's model, the coefficients of the dependent variables of the first and second hurdle are different.

The first step analyses the factors influencing the decision of farmers to adopt land-enhancing technologies, while the second step deals with the intensity of use of the adopted land-enhancing technologies.

Step 1: Probit model for the discrete adoption decision.

For the probit model, we assume that the decision of the 'i'th farmer to adopt a technology or not depends on an unobservable utility index Y_i^*, that is determined by the explanatory variables, and that the higher the value of this utility index, the higher the probability that the farmer will adopt the technology. The adoption probability (dependent variable) Y_i is limited between the values of 1 and 0.

$Y_i = \{Y_i^* \text{ if } Y_i^* > 0; 0 \text{ if } Y_i^* \leq 0\}$

The probit model is expressed as:

$$Prob(Y^*>0) = F(X'\beta) = \Phi(X'\beta) = \int_{-\infty}^{X'\beta} \O(Z)dZ$$

Where; $F(X'\beta)$ = cumulative degree of freedom of the standard normal distribution;

$Y_i^* = X'\beta + e_i$;

$X'\beta = \beta_0 + \beta_1 AGE + \beta_2 EXP + \beta_3 EDUYRS + \beta_4 SOILFERT + \beta_5 FINCOME + \beta_6 HHSIZE + \beta_7 LNDWNSHP + \beta_8 ASSN + \beta_9 PERCEPTN + \beta_{10} RISK + \beta_{11} AWARE + \beta_{12} TRAINIING + \beta_{13} EXTN$,

Where: AGE is Age (years);

EXP is Experience (years);

EDUYRS is Years of Education (years);

SOILFERT is Soil fertility (2=very fertile; 1=moderately fertile; 0=not fertile);)

FINCOME is Farm income (₦);

HHSIZE is Household size (#);

LNDWNSHP is Land ownership (3=purchased; 2=leased; 1=borrowed; 0=inherited);

ASSN is Association membership (1=member; 0=non-member);

PERCEPTN is Perception (1=positive; 0=negative);

RISK is Risk affinity (#);

AWARE is Awareness (1=aware; 0=not aware);

TRAINIING is Training (1=yes; 0=no);

EXTN is Extension contacts (#).

Step 2: Model for the continuous decision (intensity of use using uncensored observations):

$$E (Y | Y^{*}>0) = X'y + \sigma\lambda (X'y/\sigma)$$

Here the Cragg's model makes use of uncensored observations i.e. the observations with zero adoption level were not cut out of the observation, thus giving a better representation of the population.

$$X'\gamma = \gamma_0 + \gamma_1 AGE + \gamma_2 EXP + \gamma_3 EDUYRS + \gamma_4 LABOUR + \gamma_5 SOILFERT + \gamma_6 FINCOME + \gamma_7 HHSIZE + \gamma_8 LNDWNSHP + \gamma_9 ASSN + \gamma_{10} PERCEPTN + \gamma_{11} RISK + \gamma_{12} AWARE + \gamma_{13} TRAINIING + \gamma_{14} EXTN$$

Where: Y = Intensity of use;

AGE is Age (years);

EXP is Experience (years);

EDUYRS is Years of Education (years);

LABOUR is Labour (2=hired; 1=both; 0=family);

SOILFERT is Soil fertility (2=very fertile; 1=moderately fertile; 0=not fertile);

FINCOME is Farm income (₦);

HHSIZE is Household size (#);

LNDWNSHP is Land ownership(3=purchased; 2=leased; 1=borrowed; 0=inherited);

ASSN is Association membership (1=member; 0=non-member);

PERCEPTN is Perception (1=positive; 0=negative);

RISK is Risk affinity (#);

AWARE is Awareness (1=aware; 0=not aware);

TRAINIING is Training (1=yes; 0=no);

EXTN is Extension contacts (#).

Results and discussion

Socio-economic characteristics of respondents by gender

The socio-economic characteristics are presented in Table 1 by gender. The results reveal the mean age of males to be 46.46±14.42 years and that of females as 47.26±13.60 years. Therefore, implying that female farmers in the study area are only slightly older than the males in the study area. This outcome indicates that the average male and female farmers in the study area is middle aged. The mean years of formal education was 9.44±5.31 years for males and 9.36±4.91 years for females. This result is similar to the findings of Diiro et al. (2015) but differs from numerous literatures reporting large gaps in years of education between the two genders. The mean years of farming experience was 18.23±10.79 years for males and 18.14±11.86 years for females. The result further reveals that the percentage of females who belonged to associations is more than the males at 54.00% and 35.29%, respectively. This corresponds to the findings of Awotide et al. (2015) who also found the percentage of females belonging to farmer related associations to be higher than the males. The females have a higher percentage of contact with 38%, while only 33.82% of the male population have access to extension services. This result is not congruent with the findings of Diiro et al. (2015) who found the proportion of males with extension contact to be higher than females. Not much gender difference can be deduced from the mean income of the male and female subsamples of ₦ 465000 and ₦ 405850. This result is similar to the results of Awotide et al. (2015) that household income of males to be higher than the females.

Table 1. Socio-economic characteristics of respondents by gender

Variables	Male	Female	Pooled
Age (Years)	46.46±14.42*	47.26±13.60	46.79±14.03
Years of formal education	9.44±5.31	9.36±4.90	9.41±5.13
Years of farming experience	18.23±10.79	18.14±11.86	19.80±11.22
Association membership (%)	35.29	54.00	
Extension contact (%)	33.82	38.00	
Farm income (₦)	465000±308863	405854±273248	439423±294172

*± Standard deviation; *1₦ = 0.0028US$.

Land-enhancing technologies adopted by arable farmers in the study area by gender

In this study, the land-enhancing technologies were crop rotation, liming, inorganic fertilizer, and organic manure. As indicated in Table 2, of the four technologies, organic manure had the highest adoption rate with 55.08%, followed by crop rotation and inorganic fertilizer with 44.92% and 47.46%, respectively.

Liming had the lowest rate of adoption with 32.2% of respondents adopting it. The low adoption rate recorded for liming could be attributed to the fact that majority of the respondents were not aware of it. Although the proportion of male adopters is more than the females, it is important to note that among the adopters of organic manure, a larger proportion are females. This could be due to the cost, as most of the respondents reported that their reason for adopting organic manure was its very low cost as most of them got it for free.

Table 2. Adopters of land-enhancing technologies by gender

Technology	Males (%)	Females (%)	Pooled (%)
Crop rotation	47.06	42.00	44.92
Inorganic fertilizer	44.12	46.43	47.46
Liming	30.88	34.00	32.2
Organic manure	52.94	58.00	55.08

Source: Field survey, 2018

Adoption rates by gender

As shown in Table 3, some respondents adopted more than one technology. 14.41% of the respondents adopted none of these technologies, 83.59% adopted at least one, while 8.47% of the respondents adopted all four technologies. By gender, 17.65% of males did not adopt any technology, and 82.41% adopted at least one technology; while 10% of the females did not adopt any technology and 90% adopted at least one technology. This result implies that the rate of technology adoption is slightly higher among females than males. Also, only 8.82% of males and 8.00% of females adopted all the technologies. Past researches have shown that the gender of the farmer is statistically significant in influencing the rate of technology adoption, the difference in level of access to these technologies and complementary inputs and resources between the genders is what brings about the observed gender gap in adoption (Doss, 2001; Ragasa, 2012).

Table 3. Adoption rates by gender

Number of technologies adopted	Males (%)	Females (%)	Pooled (%)
None	17.65	10.00	14.41
1	22.06	30.00	25.42
2	36.74	32.00	34.75
3	14.71	20.00	16.45
All	8.82	8.00	8.47
Total	100.00	100.00	100.00

Source: Field survey, 2018

Effect of membership in association on adoption and intensity of use of land-enhancing technologies in the study area by gender

Effect of membership in association on the adoption of liming by gender: Table 4 shows the effect of membership in association on the adoption of liming by gender. Farming experience and extension contact are positively significant for both genders. Experience was significant at 10% and 5% for males and females, respectively, while extension contact was significant at 1% and 5% level of significance, respectively. This implies that increase in farming experience as well as extension contact would lead to increase in probability of adoption of liming for both genders. However, household income was found to be negatively significant at 10% level of significance for both genders. This agrees with the findings of Mwangi and Kariuki (2015). It implies that an increase in household income would lead to a decrease in probability of adopting liming. It also means that liming is being adopted by those with lower household incomes. Land status and perception of technology significantly influenced adoption of liming for males at 5%, and 10% levels of significance, respectively. Perception had a positive relationship with the probability of adoption of liming for males, which implies that the farmers who perceived liming to be simple had higher probability of adopting it. Household size, land ownership, and awareness of solutions the technology could provide had positive and significant influence on the probability of females adopting liming at 1%, 5%, and 10%, respectively.

Effect of membership in association on the intensity of use of liming by gender: Effect of membership in association on the intensity of use of liming are shown in Table 5. The perception of the farmer about the technology was found to positively influence the intensity of adoption of liming by both genders at 1% for males and 5% for females. This implies that the perception of liming as being simple rather than complex increased the intensity of its adoption by both genders, and conversely, its perception as being complex rather than simple reduced its intensity of adoption by both genders. Labour, land ownership, training and risk assessment all had significant relationships with adoption of liming at 1%, 5% and 10% level of significance, respectively, although the relationship with labour was positive, the rest were negative. This implies that farmers with hired labour had higher probability of adopting liming. Belonging to a farming related association was also found to positively and significantly affect the intensity of adoption of liming by females. This means that female farmers belonging to farming related associations have higher intensity of adoption of liming.

Effect of membership in association on the adoption of crop rotation by gender: As shown in Table 6, Household size negatively significantly influenced the adoption of crop rotation among males at 1% level of significance. This implies that increase in household size reduces the probability of males adopting crop rotation. Extension contact was also found to be positively significant in influencing males to adopt crop rotation at 5%. This implies that increase in number of extension contacts would result in increase in probability of males adopting crop rotation. However, for females, age and training were negatively significant at 5% and 10% levels of significance respectively, while perception was positively significant at 1% level of significance in influencing females to adopt crop rotation. The results imply that increase in age of females led to reduction in their probability of adopting crop rotation. Perception which had a very high level of significance, had a positive relationship with adoption of crop rotation among females, implying that the perception of crop rotation as being simple to practice, increases the probability of it being adopted by female arable farmers.

Table 4. Effect of membership in association on adoption of liming among arable farmers in the study area by gender

Variables	Males		Females	
	Coefficients	Std. Err.	Coefficients	Std Err.
Age	0.0164625 (0.66)	0.02482	-0.0438206 (-1.1)	0.03976
Experience	0.0726599* (1.78)	0.04077	0.0747745** (1.95)	0.03842
Years of education	0.0509299 (0.98)	0.05187	0.0923031 (1.09)	0.08472
Land ownership	1.177898 (1.54)	0.76258	2.705096** (2.15)	1.2583
Land status	-2.259076** (-2.4)	0.94303	0.7030116 (1.02)	0.68908
Household income	-2.47E-06* (-1.77)	1.40E-06	-3.65E-06* (-1.9)	1.92E-06
Household size	-0.0012217 (-0.03)	0.03733	0.1300854*** (2.56)	0.05074
Association membership	0.6787684 (0.93)	0.72734	-0.2958474 (-0.41)	0.71763
Perception	1.58534* (1.73)	0.91899	-0.7158789 (-0.76)	0.94307
Risk assessment	0.0632174 (1.37)	0.04627	0.0664132 (0.68)	0.09819
Awareness	1.080151 (1.44)	0.74845	1.744425* (1.74)	1.00456
Training	0.3235788 (0.58)	0.55852	-0.273562 (-0.29)	0.93123
Extension contact	2.833934*** (3.00)	0.94536	5.780805** (2.1)	2.75424
Constant	-6.6017*** (-2.69)	2.45647	-9.79624** (-2.24)	4.36593
	Number of observations = 61		Number of observations = 48	
	Prob > chi2 = 0.2523		Prob > chi2 = 0.5725	
	Log likelihood = -3.250884		Log likelihood = -1.2429288	

Source: Field survey, 2018; Figures in parentheses are t-values; ***= significant at 1%, **= significant at 5%, *= significant at 10%.

Effect of membership in association on the intensity of use of crop rotation by gender: The factors that significantly influenced the intensity of use of crop rotation by arable farmers in the study area according to gender are presented in the Table 7. The data reveals that association membership and perception of the technology positively significantly influenced the intensity of use of crop rotation among both genders. Association membership was positively significant at 5% and 1% for males and females respectively, while perception was positively significant at 10% for both genders. This implies that belonging to farmers' associations and perception of the technology as being simple rather than complex increased the intensity of adopting crop rotation for both genders. However, household income was found to negatively influence the intensity of adoption of both genders at 10% and 1% for males and females, respectively. This result implies that increase in household income reduces the intensity of use of crop rotation for both genders. Years of education was also shown to have a positive relationship with intensity of use of crop rotation by males at 5% level of significance. However, for females, this variable had a negative relationship with intensity of adoption at 1% level of significance. This implies that increase in years of education increases the intensity of males', but reduces the intensity of females' use of crop rotation. Other variables which negatively influenced intensity of use of crop rotation for females include experience, labour type, land status, attitude towards risk, awareness of solutions the technology would provide and age. The first four factors were significant at 1%, while awareness of solutions the technology would provide was significant at 5% significance level, and age at 10%. On the other hand, household size and extension contact positively influenced the intensity of use of crop rotation at 1% level of significance. Implying that increase in household size would lead to increase in intensity of use of crop rotation; and contact with extension agents also has the same effect for females.

Table 5. Effect of membership in association on intensity of use of liming by arable farmers in the study area by gender

Variables	Males		Females	
	Coefficients	Std. Err.	Coefficients	Std. Err.
Age	0.0003817 (0.1)	0.0039	-0. 0533922 (-2.34)	0. 0227776
Experience	-0.0100079 (-1.45)	0.00691	0. 0104005 (0.73)	0. 0142968
Years of education	0.0032852 (0.51)	0.00643	0. 032667 (1.49)	0.03297
Land ownership	-0.2972469*** (-3.75)	0.07919	0.2065761 (0.99)	0. 032846
Labour	0.2177547*** (2.68)	0.08121		
Land status	-0.0504225 (-0.42)	0.12043	0. 5804823 (1.61)	0. 3616701
Household income	-1.70E-07 (-0.67)	2.55E-07		
Household size	0.0096292 (1.65)	0.00585		
Association membership	-0.0510987 (-0.32)	0.15871	3034235* (1.17)	0.4118037
Perception	0.3337111*** (2.96)	0.11261	-0. 7563609** (-2.06)	0. 367251
Risk assessment	-0.023383* (-1.87)	0.01248	0. 0505636 (0.94)	0.0535264
Awareness	-0.2097865 (-1.34)	0.15651	1.280716 (2.02)	0. .6345022
Training	-0.2034331** (-2.11)	0.09645	0. .0610645 (0.14)	0. 4503233
Extension contact	-0.4380544 (-1.29)	0.33864	-0. 995795 (-1.39)	0. 7163287
Constant	1.893997*** (2.65)	0.71576	0. .4676516 (0.32)	1.451342
Sigma	0.1293049*** (6.21)	0.02081	0. .2331042*** (4.51)	0. .05163

Source: Field survey, 2018; Figures in parentheses are t-values; ***= significant at 1%, **= significant at 5%, *= significant at 10%.

Effect of membership in association on the adoption of inorganic fertilizer by gender: Tables 8 and 9 show the effect of membership in association on the adoption and intensity of use of inorganic fertilizers, respectively, among the arable farmers in the study area by gender. For males, attitude towards risk was found to have a negatively significant relationship with adoption of inorganic fertilizer at 5% level of significance. This implies that farmers with negative attitude towards risk had higher probability of adopting inorganic fertilizers. This could be due to the fact that farmers who do not want to risk losses or crop yield would do their best possible to enrich the soil, hence their higher chances of adopting inorganic fertilizer.

Effect of membership in association on the intensity of use of inorganic fertilizer by gender: Labour was found to have a negatively significant relationship with intensity of adoption of inorganic fertilizer at 10% level of significance for both genders (Table 9). This implies that farmers who made use of hired labour had higher intensity of use of inorganic fertilizers. This could be due to the fact that farmers who make use of hired labour are market oriented and have goals of increasing output, and hence the higher the intensity of use of inorganic fertilizers after adopting it. Other factors that influenced the intensity of use of inorganic fertilizers by male farmers include age, risk, association membership and experience. Age and risk were negatively and positively related to intensity of use of inorganic fertilizers at 1% level of significance, respectively. This means that older farmers have lower intensity of use of inorganic fertilizer. This could be related to the production of older farmers being most of the subsistence form, hence they do not see the need for optimum application of inorganic fertilizer. Some of them also consider the inorganic fertilizers as detrimental to their health and therefore apply fertilizer below the recommended levels.

The negative relationship with household size implies that increase in household size would lead to decrease in intensity of inorganic fertilizer application. This could be because farmers with large household size could choose to make their production labour intensive rather than capital intensive due to the availability of free and cheap labour.

Effect of membership in association on the adoption of organic manure by gender: The factors influencing the adoption and intensity of use of organic manure among the arable farmers in the study area are presented in Tables 10 and 11. Extension contact significantly, but negatively influenced the adoption of organic manure by both genders at 1% and 5% for males and females, respectively. This implies that farmers with extension contact had lower probability of adopting organic manure. This could be due to the fact that extension contact exposes the farmers to other land-enhancing technologies other than organic manure, which they find preferable to organic manure. A major reason for farmers preferring alternatives to organic manure is its offensive odour. Awareness of solutions the technology could bring negatively influenced adoption by males at 10% level of significance, but had the reverse effect at the same level of significance for females. This means that for females, awareness increased their probability of adoption of organic manure, while it reduced the probability of adoption for males.

Table 6. Effect of membership in association on the adoption of crop rotation by arable farmers in the study area by gender

Variables	Males		Females	
	Coefficients	Std. Err.	Coefficients	Std. Err.
Age	-0.0052 (-0.31)	0.0166	-0.0660** (-2.39)	0.0277
Experience	0.0300 (1.40)	0.0214	0.0063 (0.24)	0.0261
Years of education	0.0608 (1.63)	0.0374	-0.0352 (-0.69)	0.0514
Land ownership	-0.0528 (-0.13)	0.4055	0.6025 (1.39)	0.4326
Land status	-0.1518 (-0.34)	0.4517	-0.3338 (-0.8)	0.4181
Household income	1.01e-06 (1.22)	8.29e-07	-0.000000559 (-0.61)	9.14e-07
Household size	-0.0840*** (-2.70)	0.0311	-0.0039 (-0.16)	0.0252
Association membership	0.6517 (1.55)	0.4209	0.0567 (0.12)	0.4910
Perception	-0.5341 (-1.04)	0.5139	1.5836*** (2.71)	0.5849
Risk assessment	-0.0041 (-0.12)	0.0346	-0.0389 (-0.71)	0.0549
Awareness	0.0241 (0.06)	0.4053	-0.3313 (-0.64)	0.5147
Training	-0.0452 (-0.11)	0.4246	-1.0502* (-1.85)	0.5670
Extension	0.9669** (1.97)	0.4919	0.6378 (1.08)	0.5904
Constant	-0.7005 (-0.62)	1.1355	3.7001* (1.75)	2.1137
	Number of observations = 61 Prob > chi2 = 0.3906 Log likelihood = -25.025044		Number of observations = 48 Prob > chi2 = 0.5140 Log likelihood = -9.2491755	

Source: Field survey, 2018; Figures in parentheses are t-values;***= significant at 1%, **= significant at 5%, *= significant at 10%.

Other factors that influenced the adoption of organic manure by males were age, years of education and training which had negative relationships with adoption at 1%, 10% and 10% levels of significance, respectively. This means that older, more educated male farmers as well as those who had received training on land-enhancing technology had lower probability of adopting organic manure. This could be the result of their exposure to more sophisticated land-enhancing methods and technologies. However, years of farming experience had a positively significant relationship with adoption of organic manure by male farmers at 5% level of significance.

For females, other factors that influenced adoption of organic manure include land status, perception, household income and association membership. Land status had a positive relationship with adoption of organic manure by females at 10% level of significance, implying that females who considered their land to be fertile chose to adopt organic manure. This could probably be because farmers who consider their land as fertile do not feel the need to expend time and cost on other forms of land-enhancing technologies and choose to adopt organic manuring instead. Association membership also had a negative relationship with adoption of organic manure by females at 5% level of significance. This could be due to the fact that farmers who membered in farmer related associations had exposure to other technologies they considered better and hence had higher probabilities of not adopting organic manure. Perception had positive significance at 5% also, implying that female arable farmers who considered organic manuring to be a simple technology had higher probability of adopting it.

Table 7. Effect of membership in association on the intensity of use of crop rotation among arable farmers in the study area by gender

Variables	Males		Females	
	Coefficients	Std. Err.	Coefficients	Std. Err.
Age	-0.0122 (-1.56)	0.0078	-0.0069* (-1.67)	0.0041
Experience	-0.0018 (-0.27)	0.0067	-0.0260*** (-3.01)	0.0087
Years of education	0.0276** (2.41)	0.0115	-0.0940*** (-4.8)	0.0196
Land ownership	0.0202 (0.13)	0.1517	0.2270* (1.7)	0.1333
Labour	0.033 (0.41)	0.0809	-0.3934*** (-4.47)	0.0881
Land status	-0.2241 (-1.19)	0.1878	-0.6953*** (-3.78)	0.1837
Household income	-5.67e-07* (-1.77)	3.20e-07	-1.93e-06*** (-5.74)	3.36e-07
Household size	-0.0104 (-1.31)	0.0079	0.0488*** (3.86)	0.0126
Association membership	0.2486** (2.22)	0.1121	0.4168*** (3.64)	0.1143
Perception	0.3119* (1.67)	0.1869	0.2487* (1.82)	0.1367
Risk assessment	-0.0091 (-0.97)	0.0094	-0.0656*** (-3.66)	0.0179
Awareness	0.0208 (0.18)	0.1188	-0.2572** (-2.14)	0.1200
Training	-0.0461 (-0.38)	0.1201	0.1296 (1.48)	0.0876
Extension	-0.0189 (-0.13)	0.1415	0.8696*** (3.98)	0.2187
Constant	1.2685*** (2.77)	0.4574	3.3651*** (5.15)	0.6538
Sigma	0.2177*** (6.22)	0.0350	0.1454*** (6.16)	0.0236

Source: Field survey, 2018; Figures in parentheses are t-values;***= significant at 1%,
**= significant at 5%, *= significant at 10%.

Effect of membership in association on the intensity of use of organic manure by gender: Land status and household income positively significantly influence the intensity of use of organic manure by males at 10% significance level (Table 11). This implies that male farmers who considered their land to be fertile chose to adopt organic manure as their land-enhancing technology. Extension contact had positive relationship with intensity of use of organic manure by females at 5% level of significance, implying that female farmers with extension contact use organic manure more intensely than those who do not. Labour type had negative relationship with intensity of organic manure usage among females at 5% level of significance. This implies that female farmers who make use of hired labour use organic manure less intensely than those who use family labour.

Table 8. Factors influencing the adoption of inorganic fertilizer by arable farmers in the study area

Variables	Males		Females	
	Coefficients	Std. Err.	Coefficients	Std. Err.
Age	-0.0251426 (-1.38)	0.0181697	.0080682 (0.41)	.0197116
Experience	0.0152875 (0.65)	0.0236944	0.0156322 (0.68)	.0229698
Years of education	-0.0486908 (-1.28)	0.037895	-0.0453509 (-0.98)	.0461702
Land ownership	0.4022997 (0.99)	0.4074663	0.6763161* (1.75)	.3856335
Land status	-0.7370458 (-1.6)	0.46115	0.3170152 (0.73)	.4325052
Household income	-7.48e-07 (-0.91)	8.25e-07	0.0000012 (1.39)	8.65e-07
Household size	0.0045029 (0.17)	0.0272209	0.0334113 (1.25)	.0267261
Association membership	-0.3770385 (-0.84)	0.4479951	0.6742952 (1.43)	.4712416
Perception	0.6910022 (1.4)	0.4953331	0.3944512 (0.78)	.5073302
Risk assessment	-.067782** (-2.02)	0.0336113	0.0814394 (1.53)	.0531461
Awareness	.5949155 (1.33)	0.4461404	-0.5544273 (-1.1)	.5035802
Training	0.8881216 (2.07)	0.4287575	0.0486849 (0.11)	.4614721
Extension	0.1082692 (0.25)	0.4387697	0.7786647 (1.39)	.5607959
Constant	2.15923* (1.78)	1.210473	-4.566992** (-2.1)	2.171195
	Number of observations = 61 Prob > chi2 = 0.1910 Log likelihood = -15.689484		Number of observations = 61 Prob > chi2 = 0.4589 Log likelihood = -19.383463	

Source: Field survey, 2018; Figures in parentheses are t-values;***= significant at 1%, **= significant at 5%, *= significant at 10%.

Table 9. Effect of membership in association on the intensity of use of inorganic fertilizer among arable farmers in the study area by gender

Variables	Males		Females	
	Coefficients	Std. Err.	Coefficients	Std. Err.
Age	-.0160894*** (-2.87)	.005603	0.003233 (0.76)	.004257
Experience	.0104278* (1.67)	.0062429	-0.0094435 (-1.23)	.0076577
Years of education	-0.0007864 (-0.1)	.0080533	-0.0222673 (-1.38)	.0161584
Land ownership	-.3884643*** (-3.33)	.1168135	-0.2184468 (-1.37)	.1594675
Labour	-0.1314134* (-1.89)	.0695624	-.2072858* (-1.7)	.1218644
Land status	0.1272219 (1)	.1270953	0.0595783 (0.36)	.164831
Household income	-8.79e-07 (-0.54)	1.63e-07	-0.000000189 (-0.8)	2.36e-07
Household size	-0.0029119 (-0.37)	.0078082	-.024807* (-1.94)	.0127607
Association membership	.2438** (2.17)	.1121448	0.12208 (0.72)	.1696541
Perception	0.0172555 (0.16)	.1097555	-0.0556199 (-0.44)	.1252807
Risk assessment	.0305404*** (3.6)	.0084787	-0.0009261 (-0.04)	.0210071
Awareness	0.2261415 (1.43)	.1579329	-0.1048169 (-0.68)	.155019
Training	-0.0554154 (-0.57)	.0978414	-0.0759826 (-0.68)	.112038
Extension	0.0117635 (0.09)	.1281465	-.4131772** (-2.12)	.1948727
Constant	0.3342668 (1.01)	.3314754	1.796479* (1.63)	1.104805
Sigma	.1750575*** (6.4)	.0273726	.2286039*** (5.85)	.0390445

Source: Field survey, 2018; Figures in parentheses are t-values;***= significant at 1%, **= significant at 5%, *= significant at 10%.

Table 10. Effect of membership in association on the adoption of organic manure of arable farmers in the study area by gender

Variables	Males		Females	
	Coefficients	Std. Err.	Coefficients	Std. Err.
Age	-.0942*** (-2.64)	.0356	-0.0162 (-0.68)	.0237
Experience	.07482** (2.01)	.0372	0.0408 (1.39)	.0293
Years of education	-.1022* (-1.71)	.0597	-0.01 (-0.19)	.0532
Land ownership	0.0929 (0.19)	.4806	-0.5078 (-1.02)	.4970
Land status	-0.6064 (-1.09)	.5579	1.0661* (1.79)	.5947
Household income	-0.00000247 (0.82)	9.27e-07	0.00000394*** (2.91)	1.36e-06
Household size	-0.0284 (-0.78)	.0363	-0.0302 (-0.92)	.0328
Association membership	-0.0032 (-0.01)	.5186	-1.1854** (-2.12)	.5580
Perception	0.986 (1.4)	.7036	1.4081** (2.29)	.6159
Risk assessment	0.0422 (1.08)	.0392	0.029 (0.46)	.0626
Awareness	-1.3260* (-1.71)	.7762	1.3926* (1.86)	.7489
Training	-1.0602* (-1.71)	.6183		
Extension	2.7058*** (3.23)	.8384	-2.1572** (-2.49)	.8675
Constant	3.0766* (1.71)	1.800	-0.9618 (-0.43)	2.256
	Number of observations = 61		Number of observations = 48	
	Prob > chi2 = 0.3347		Prob > chi2 = 0.4992	
	Log likelihood = -16.25531		Log likelihood = -7.4992002	

Source: Field survey, 2018; Figures in parentheses are t-values;***= significant at 1%, **= significant at 5%, *= significant at 10%.

Table 11. Effect of membership in association on the intensity of use of organic manure of arable farmers in the study area

Variables	Males		Females	
	Coefficients	Std. Err.	Coefficients	Std. Err.
Age	-0.0038 (-0.73)	.0052	-0.0026 (-0.85)	.0031
Experience	0.001 (0.14)	.0072	-0.003 (-0.7)	.0044
Years of education	0.0108 (1.24)	.0087	-0.0053 (-0.65)	.0081
Land ownership	-0.142 (-1.12)	.1268	-0.3129 *** (-3.19)	.0982
Labour	-0.1666 (-1.63)	.1022	-0.1633** (-2.22)	.0737
Land status	.2756* (1.89)	.1460	-0.0811 (-1.17)	.0692
Household income	4.2e-07* (1.92)	2.20e-07	-1.46e-07 (-0.91)	1.60e-07
Household size	-0.0055 (-0.77)	.0072		
Association membership	0.154 (1.15)	.1342	0.1195 (1.34)	.0890
Perception	-.2940** (-2.1)	.1400	-0.1716 (-1.61)	.1069
Risk assessment	0.0016 (0.18)	.0091	0.0126 (1.46)	.0086
Awareness	0.156 (1.33)	.1172	-0.1113 (-1.04)	.1074
Training	-0.0238 (-0.24)	.0998	-0.0774 (-0.86)	.0894
Extension	-0.1568 (-1.08)	.1451	0.3253** (2.56)	.1269
Constant	0.5549 (1.35)	.4097	0.7745** (2.71)	.2860
Sigma	.2248*** (6.68)	.0337	0.1752*** (7.04)	.0249

Source: Field survey, 2018; Figures in parentheses are t-values;***= significant at 1%, **= significant at 5%, *= significant at 10%.

Conclusion

The study in Ogun State concluded that: the arable farming is male dominated; the average male and female farmers are middle aged; the majority of the males and females in the population have primary school level of education; the higher percentage of the males have farming experience of 11-20 years; more of the females belong to farming related associations than males and they also have more access to extension contact than the males; on the average, males have slightly higher incomes than the females; although organic manure had the highest adoption rate for both genders, its intensity of use (adoption index) was the lowest, the females having even lower intensity of use than males although they (the females) had the highest rate of adoption of organic manure. The results from the Cragg's double hurdle model show that extension contact and membership in association significantly influenced the adoption of most of the technologies. It had a positive relationship with the adoption of all the technologies across both genders, except organic manure which was negatively related for both genders. On the other hand, membership in association, labour type and perception of the technology as complex or simple, influenced intensity of use of technologies across the genders the most. Intensity of use of the technologies by females was mostly significantly influenced by labour type, while the perception of technology influenced the intensity of adoption for males the most. Thus, the following recommendations have been proffered based on the findings of this study: (i) Extension services should be made more available and efficient in order to reach more women farmers to improve their adoption and intensity of use of land-enhancing technologies; (ii) Relevant agencies and stakeholders should reach out to female arable farmers through their associations, as majority of the female farmers have been found to belong to farming associations.

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