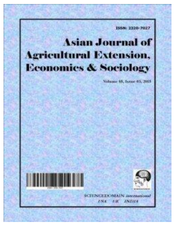

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Factors Influencing Farmer's Choice of Adaptation Measures to Climate Change among Smallholder Arable Farmers in Kogi State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Adaptation has the potential to significantly contribute to reductions in negative impacts from changes in climatic conditions. The study investigated the factors influencing farmer's choice of adaptation measures to climate change among smallholder arable farmers in Kogi State, Nigeria. Multistage random sampling technique was used to select one hundred and sixty (160), respondents. Data collected from the study were analyzed using descriptive statistics, logit regression and constraints encounter index. The result obtained from the analyses showed that average age of smallholder arable farmers in the study area was 46 years with a majority (72.5%) being male. On the level of education of the farmer, about (18.1%) of the farmers had no formal education while majority (81.9%) had various forms of formal education. 34.4% of the respondents were within 11-20 years of farming experience with large household size 11 above member representing 45.0%. Logit regression model results reveal that major socio-economic factors of arable farmers influencing farmer's choice of various adaptation measures include age, educational status, gender, marital status, household size, farming experience, farm size, the fertility of the soil, membership of cooperative/farmers group, extension visit and access to credit. Constraints encounter index revealed that major constraint encountered include lack of information on climate

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change, lack of technology necessary for adaptation, lack of necessary inputs, lack of climate forecasting technology, limited knowledge on adaptation to climate issues, poor financial resource, lack of government policy on climate change, poor potential for irrigation, difficulty in shifting from cropping patterns in short duration, and lack of infrastructure. This study concludes that various socio-economic and personal attributes had strong impacts on arable farmer's choice of adapting to different adaptation measures available in the study area. Government should place priority on determining factors of adaptation and barriers to adaptation measure into climate change-related policies.

Keywords: Adaptation; arable; climate change; factors; measures.

1. INTRODUCTION

Climate change has become a new reality with deleterious effects such as disrupted seasonal cycle, disrupted ecosystems and agriculture, water needs, water supply and food production are all adversely affected. Climate change also leads to sea-level rise with its attendant consequences and includes fiercer weather, increased frequency, intensity of storms, floods, hurricanes, droughts, increased frequency of fires, poverty, malnutrition and series of health and socio-economic consequences. Nigeria like all other countries of sub-Saharan Africa is highly vulnerable to the impacts of climate change (NEST, 2004, IPCC, 2007 and [1]).

Small-holder farm holdings predominate in Nigeria and accounted for about 94% of total agricultural output [2]. Agriculture is one of the sectors most vulnerable to global warming impact in Africa [3]. Adaptation is the process of improving society's ability to cope with changes in climatic conditions across time scales, from short-term (like seasonal to annual) to the long-term (like. decades to centuries). Adaptive capacity as the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities or to cope with the consequences.

Adaptation occurs at two main scales; first the farm-level that focuses on micro-analysis of farmer decision making and secondly the national level or macro-level that is concerned about agricultural production at the national and regional scales and its relationships with domestic and international policy [4,5] The goal of an adaptation measure should be to increase the adaptive capacity of a system to survive external shocks or change.

The assessment of farm-level adoption of adaptation measures is important to provide information that can be used to formulate policies that enhance adaptation as a tool for managing a variety of risks associated with climate change in agriculture. Important adaptation options in the agricultural sector include: Crop diversification, mixed crop-livestock farming systems using different crop varieties, changing planting and harvesting dates and mixing less productive, drought-resistant varieties and high-yield water sensitive crops [5]. This research was therefore carried out to assess the socio-economic characteristics of the smallholder arable farmers in the study area and to identify the factors that influence smallholder arable farmer’s choice of different adaptation measures in the study area.

2. METHODOLOGY

The study was conducted in Kogi State, Nigeria. Kogi Stateis located in the central region of Nigeria. It is popularly called the confluence state because the confluence of river Niger and river Benue is at the capital. Kogi State was created on 27th August, 1991 and lies on latitude 7^{0}49′ 00″N and longitude 6^{0}45′ 00″E with a geographical feature depicting young sedimentary rocks and alluvium along the riverbeds which promotes agricultural activities. Kogi State has an average maximum temperature of 33.2°C and average minimum temperature of 22.8°C. Lokoja the state capital is generally hot throughout the year. The state has distinct weather condition viz; dry season which last from November to February and rain season that last from March to October. The annual rainfall ranges from 1016 mm to 11524 mm. Kogi State has a total land area of 28,313.53 square kilometers, a projected population of 3.8 million people (NPC, 2011) and if the population growth would be same as in period 2006-2011 (+3.05%/year), Kogi State population would be 4.6 million people by the end of 2017 [6]. Kogi State shares boundaries with Abuja FCT to the north, Nasarawa State to the northeast, Benue State to the east, Enugu State to the southeast, Anambra State to the south, Edo State to the southwest, Ondo State to the west, Ekiti State to the west, Kwara State to the northwest and Niger State to the north. The state which is structured into 21 Local Government Area, comprises of three major ethnic groups that is Igala, Ebira and Okun (Yoruba) and other minor groups which include Bassakomo, BassaNge, Kakanda, Nupe, Ogori, Kupa, Oworo and Gwari etc.

A multi-stage random sampling technique was employed in selecting the respondents for this study. In the first stage, two Local Government Areas each were purposively selected from each of the four agricultural zones in the study area based on predominant agricultural activities and information from zonal extension services. The agricultural zones are zone A, B, C and D. this sum up to eight (8) local government areas in the study area. In the second stage, two communities were randomly selected from each of the Local Government Areas. This gives rise to four (4) communities per agricultural zone, totaling sixteen (16) communities. The third and final stage involved random selection of 10 arable farmers each from the sixteen (16) communities earlier selected for this study. Therefore, one hundred and sixty (160) respondents were used for this study. Data were gathered from primary source through administration of well-structured questionnaire and personal interview. Data collected were analyzed using descriptive statistics such as frequency, percentage, mean etc., logit regression model and constraint encounter index.

2.1 Model Specification

Logit model is given by

$$\text{Pj} = \Pr(Y_i = j) = \frac{e^{\beta_j X_{ij}}}{1 + \sum e^{\beta_m X_{ij}}} \qquad (1)$$

Where:

- $\Pr(Y_i=j_i)$ = probability of choosing adaptation measure
- j = number of climate change adaptation options in the choice set.
- X_i = vector of the predictor (exogenous) socio economic factors (variables)
- B = vector of the estimated parameters.

The relative seriousness of constraints the farmer encountered while adapting to climate change was calculated based on the following index formula

$$CEI = CE_{NS}\,X\,1 + CE_{LS}\,X\,2 + CE_S\,X\,3 + CE_{VS}\,X\,4 \qquad (2)$$

Where:

- CEI = Constraint Encounter Index
- CEI_{NS} = Frequency of farmers rating constraint as not serious
- CE_{LS} = Frequency of farmers rating constraint as less serious
- CE_S = Frequency of farmers rating constraint as serious
- CE_{VS} = Frequency of farmers rating constraint as very serious

3. RESULTS AND DISCUSSION

3.1 Socio-economics Characteristics of Respondents

Socio-economic characteristics of smallholder arable farmers refer to their human qualities that could enhance their agricultural production and climate change adaptation. These attributes also assist in getting a vivid understanding of the behaviour of these farmers which may give a clue towards explaining their disposition that could bring about increase in production and adaptation to prevailing climatic condition.

Result in Table 2 shows the distribution of the respondents according to their socio-economic characteristics. The result on sex (gender) shows that 72.5% of the farmers were male and 27.5% represents female farmers. This indicates that male farmers dominate farming enterprise in the study area. The results on age in Table 2 reveal that large portion of the farmers falls within the age bracket 51-61 years representing 36.9%. This is followed by those between 31-40 years (26.2%), 17.5% falls within 41-50 years, 11.2% of the farmers were within the age above 61 years, and 8.1% falls within 41-50 years with mean age of 46 years. This indicates that the farmers were old enough to give reasonable responses on climate change issues experienced over the years. The findings agreed with the finding of Ifeanyi-Obi et al. [7] that majority of the respondents was between 41-60 years with mean age of 45 years. Similarly, the findings conforms to report that farmers in the study area had mean age of 48 years and 47 years respectively [8,9]. Farmers who perceived changes in climate were within 31-60 years of age compared to farmers below 30 years and above 60 years of age [10].

Result on household size (Table 2) reveals that fairly majority (45.0%) had household size above 11 members, 33.1% had household size between 5-10 members, while 21.9% had household size between 0-5 members with mean of 10 members. This implies that the farmers in the study area maintain large family size and could be a boost to farm labour during planting season. The finding agrees with previous study that reported that farmers in the study area maintain fairly large family size with a mean of 6 members [11].

Result on educational status of the respondents reveal that (18.1%) of the respondents had no formal education while majority (81.9%) had various forms of formal education. This implies that most farmers were literate enough to adopt adaptation measures brought to them by extension agents as well as other agents. The finding conforms to the finding by Ayanwuyi et al. [12] that majority of the farmers were literate. Results (Table 2) also revealed that majority (78.1%) of the farmers have farm size between 1-5 hectares, 13.8% own above 5 hectares while 8.1% own less than 1 hectare with mean farm size of 5 hectares. This implies that majority of the farmers are smallholder which were the target of this study.

Result on farming experience reveals that 13.8% of the farmers have been in the farming enterprise between 0-10 years, 34.4% has been farming for between 11-20 years, 22.5% has been farming between 21-30 years, and 20.0% has been farming for 31 to 40 years while 9.4% has been farming for more than 41 years with mean of 24 years. This indicate that the farmers in the study have stayed long enough in farming enterprise and as such have acquired wealth of knowledge over the time both on farming matters and climate change adaptation measures. This finding is in line with a report that majority of farmers who perceived climate is changing had farming experience above 10 years and 5 years [10,11].

Table 1. Socio-economics characteristics of respondents

Variables	Response	Frequency	Percentage	Mean
Age (years)	21-30	13	8.1	46
	31-40	42	26.2	
	41-50	59	36.9	
	51-60	28	17.5	
	61above	18	11.2	
Sex	Male	116	72.5	10
	Female	44	27.5	
Household size (numbers)	0-5	35	21.9	5
	6-10	53	33.1	
	11 above	72	45.0	
Level of educational	No formal education	29	18.1	24
	Primary education	37	23.1	
	Secondary education	56	35.0	
	Tertiary education	38	23.8	
Farm size (Hectares)	<1	13	8.1	
	1-5	125	78.1	
	>5	22	13.8	
Farming experience (years)	0-10	22	13.8	
	11-20	55	34.4	
	21-30	36	22.5	
	31-40	32	20.0	
	41 above	15	9.4	

Source: Field Survey, 2016

3.2 Factors Influencing Farmer's Choice of Adaptation Measures

The estimated coefficients of the Logit regression analysis presented in Table 2 shows the coefficients of socio-economic characteristics ascribes on adaptation had positive and negative signs. A positive sign suggests that as levels of these attributes increase from the status quo, the probability of perceiving climate change and adapting to it increases. Contrastingly, a negative sign suggests that as levels of these attributes increase from status quo, the probability of perceiving and adapting to climate change decreases.

Age: Estimated parameters for age of the farmers were positively significant across planting of disease resistant crops (0.052**), irrigation (0.055**), and were statistically significant at 5% which indicates that, age of the farmers had strong and positive influence on farmer's choice of choosing planting of disease resistant crops and irrigation. Exp (β) indicates that, the odds of choosing planting of disease resistant crops and irrigation increase by a factor of 1.053 and 1.056 unit increase in age respectively. This implies that older farmers tend choose planting of disease resistant crops and irrigation as adaptation measures than younger ones. This result agree with Deressa et al. [13], who also found that age of the farmers shows positive relationship, with more matured and experienced farmers adapting to climate change. This result disagree with Seo et al. [14] and Nolyon et al.[15]. who found that age of the farmers negatively influence adaptation to climate change.

Age of the farmers were negatively significant across use of multiple improving planting dates (-0.048**), changing of planting and harvesting dates (-0.041**), deeper planting than usual (-0.043), and were statistically significant at 5%, 5% and 10% respectively. The exp (β) indicates that, the odds of choosing use of multiple improving planting dates, changing of planting and harvesting dates, and deeper planting than usual decrease by a factor of 0.953, 0.960 and 0.958 for a unit increase in age respectively. This implies that, younger farmers were more likely to choose use of multiple improving planting dates, changing of planting and harvesting dates, and deeper planting than usual than older farmers. This result agree with a study by Nolyn et al. [15], Obayelu et al. [16] and Seo et al. [14]. found that age of the farmers negatively influenced adaptation to climate change.

Educational Status: Educational status were negatively significant across use of multiple improving planting dates (-0.097**), changing of planting and harvesting dates (-0.093**), and were statistically significant at 5% respectively. This implies that educational status of the farmers had strong but negative influence on farmer's choice of choosing use of multiple improving planting dates, and changing of planting and harvesting dates. The exp (β) indicates that, the odds of choosing use of multiple improving planting dates, and changing of planting and harvesting dates as adaptation measures decreases by a factor of 0.908 and 0.911 for a unit increase in level of education. These results disagree with the finding of Nolyn et al. [15], that level of education had no significant influence on adaptation to climate change.

Educational status were positively significant across tillage (0.076**), irrigation (0.094**), and were statistically significant at 5% respectively. This implies that educational status of the strong and positive influence on farmer's choice of choosing tillage and irrigation. The exp (β) indicates that, the odds of choosing tillage and irrigation increases by a factor of 1.079 and 1.098 for a unit increase in level of education. This is in consistent to the findings of Kebede et al. [17] which posited that a positive relationship exists between the number of years of experience in agriculture and the adoption of improved agricultural technologies in Ethiopia. This implies that farmers with higher levels of education are more likely to adapt better to climate change. Level of education attained by farmers determines their ability to perceive, interpret and correctly determine actions that would possibly enhance their performance in farming activities [18]. Dhaka [19] and Gbetibouo [20] who reported that the level of education attained by an individual goes a long way in shaping his personality, attitude to life and adoption of improved practices or adverse conditions as the case may be.

Gender: Gender (Male headed) of households are more likely to get information about new technologies and undertake risky businesses than female-headed households [21] Theestimated parameters for farmer's gender were positively significant across planting of early maturing crops (1.267**), mulching (1.719**), planting of disease resistant crops (1.108**), uses of drought tolerant crops (0.980**), and were statistically significant at 5% respectively. This implies that, gender of the farmers had strong and positive influence on farmer's choice of choosing planting of early maturing crops, mulching, planting of disease resistant, and uses of drought tolerant crops. The exp (β) indicates that, the odds of choosing planting of early maturing crops, mulching, planting of disease resistant, and uses of drought tolerant crops as adaptation measures increases by a factor of 3.549, 5.580, 3.028 and 2.663 for a unit change in gender respectively. These results agree with a study by Tagel et al. [22] found that sex of household head significantly influenced adaptation to climate change.

The result also reveals that farmer's gender were negatively significant across changing of farm size (-0.969**), drainage (-1.554**), diversifying from farm to off farm activities (-1.592***), and were statistically significant at 5%, 5% and 1% respectively. This implies that, gender of the farmers had strong and negative influence on farmer's choice of choosing changing of farm size, drainage and diversifying from farm to off farm activities. The exp (β) indicates that, the odds of choosing changing of farm size, drainage and diversifying from farm to off farm activities decreases by a factor of 0.380, 0.211 and 0.203 for a unit change in gender of the farmers respectively. These findings contrary to the findings by Tagel et al. [22] found that sex of household head significantly influenced adaptation to climate change. These results agree with a study by Nhemachena and Hassan [23] in Southern African.

Marital Status: Marital status were positively significant across planting of different varieties of crops (0.893**), mulching (0.770*), and were statistically significant at 5% and 10% level of significance respectively. This result implies that, marital status of the farmers had strong and positive influence on farmer's choice of choosing planting of different varieties of crops and mulching as adaptation measures to climate change. The exp (β) indicates that, the odds of choosing planting of different varieties of crops and mulching among farmers in the study area increases by a factor of 1.966 and 2.160 for a unit change in marital status respectively. These results agrees with a study by Gutu et al. [24], who reported that marital status of household head were found to be significant and determinant of adaptation to climate change.

Household Size: The estimated parameters for farmer's household size were negatively significant across planting of early maturing crops (-0.547*), uses of multiple improving planting dates (-0.828**), planting of disease resistant crops (-0.684**), deeper planting than usual (-0.735**), and were statistically significant at 10%, 5%, 5%, and 5% respectively. This implies that household size had a strong and negative influence on farmer's choice of choosing planting of early maturing crops, uses of multiple improving planting dates, planting of disease-resistant crops and deeper planting than usual. The exp (β) indicates that, the odds of choosing planting early maturing crops, uses of multiple improving planting dates, planting of disease resistant crops and deeper planting than usual decreases by a factor of 0.578, 0.437, 0.609 and 0.480 for a unit increase in household size respectively. This is consistent with the findings of Apata et al. [1] that household size had a negative influence on adaptation to climate change among arable food crop farmers in South Western Nigeria.These findings contrasts with findings of Tagel et al. [22] and Peter et al. [25] that found household size increases the probability of adapting to changing climate.

Farming Experience: Farming experience has negative coefficient on the likelihood of the farmers to adapt uses of planting ahead of rain (-0.684*) and was statistically significant at 10% level of significance. This implies that, household size had a strong and negative influence on farmer's choice of choosing planting ahead of rain. The exp (β) indicates that, the odds of choosing planting ahead of rain decreases by a factor of 0.408 for a unit increase in years of experience. These agrees with a study by Adesina and Forson, [26], reported that older farmers are more risk-averse and less likely to be flexible than younger farmers and thus have a lesser likelihood of adopting new technologies. The result is in contrary to the finding of Nhemehena and Hassan [23], reported that farming experience enhanced the probability uptake of adaptation as experienced farmers had better knowledge and information on changes in climatic condition. The finding also disagree with a study by Peter et al. [25]. who also found that more experienced farmers were more likely to adapt very high to climate change than the low experienced farmers.

Farm Size: The estimated parameters of farmer's farm size had positive coefficient on the likelihood of the farmer to adapt planting of early maturing crops (1.125**), uses of multiple improving planting dates (1.123**), drainage (1.165**), deeper planting than usual (1.899***) and were statistically significant at 5%, 5%, 5% and 1% respectively. This implies that, farm size had strong and positive influence on farmer's choice of choosing planting early maturing crops, uses of multiple improving planting dates, drainage and deeper planting than usual. The exp (β) indicates that, the odds of choosing planting early maturing crops, uses of multiple improving planting dates, drainage and deeper planting than usual increases by a factor of 3.081, 3.075, 3.207 and 6.679 for a unit increase in farm size respectively. Given the uncertainty and the fixed transaction and information costs associated with innovation, there may be a critical lower limit on farm size that prevents smaller farms from adapting [27,20,28]. Thus, large mechanized farms will probably be the first to adapt to climate change.

These result agrees with a study by Tagel et al. [22], reported that farm size increase the probability of adapting to climate. Amsalu and Graaff [29] reported that farmers with large farm holdings were likely to invest in adaptation measure in Ethiopian highlands. The results from this study also agrees with argument that larger farms offer farmers more flexibility in their decision-making process, more opportunity to take up new practices on trial basis, and more ability to deal with risks [30].

Soil Fertility: Estimated coefficient of soil fertility were significant across uses of drought tolerant crops (0.144**), planting of disease resistant crops (1.467***), diversifying from farm to off-farm activities (0.711**), planting ahead of rain (-0.899**), and were statistically significant at 5%, 1% 5% and 5% respectively. This implies that soil fertility had strong and positive influence on farmer's choice of choosing uses of drought tolerant crops, planting of disease resistant crops, diversifying from farm to off farm activities, and had negative influence on farmer's choice of choosing planting ahead of rain. The exp (β) indicates that, the odds of choosing uses of drought tolerant crops, planting of disease resistant crops and diversifying from farm to off farm activities increases by a factor of 2.840, 4.335, 2.036, and the odds of choosing planting ahead of rain decreases by 0.407 for a unit change in soil fertility respectively.

Membership of Cooperative/farmers Groups: Cooperatives support and encourage members to maintain, improve production practices as an adaptation strategy [31]. Membership of cooperative/farmer's group were statistically significant across planting of different varieties of crops (-1.688***), tillage (-1.028**), mulching (-2.239***), planting of disease resistant crops (-1.764**), planting ahead of rainfall (-2.588***), irrigation (-1.113**), changing of planting and harvesting dates (1.168**), and were statistically significant at 1%, 5%, 1%, 5%, 1% and 5% respectively. This implies that, membership of cooperatives/farmer's groups had strong and negative influence on farmer's choice of choosing planting of different varieties of crops, tillage, mulching, planting of disease resistant crops, planting ahead of rainfall, and had positive influence on farmer's choice of choosing changing of planting and harvesting dates. The exp (β) indicates that, the odds of choosing planting of different varieties of crops, tillage, mulching, planting of disease resistant crops, planting ahead of rainfall decreases by a factor of 0.185, 0.358, 0.107, 0.171, 0.081, and the odds of choosing changing of planting and harvesting dates increases by 3.216 for a unit change in membership status respectively. Brenda [31] reported that cooperative membership plays role of combating climate change with various sustainable and environmentally friendly practice.

Extension Visit: Access to extension makes it possible for famers to be aware of climatic conditions and the various management practices to adapt climate extremes [20]. Estimated parameter for extension visits were statistically significant across planting of different varieties crops (-1.257**), planting of early maturing crops (-0.871*), uses of fertilizer (-0.862*), irrigation (-1.922***), and were statistically significant at 5%, 10%, 10% and 1% respectively. This implies that, extension visit had strong and negative influence on farmer's choice of choosing plating of different varieties of crops, planting of early maturing crops, uses of fertilizer and irrigation. The exp (β) indicates that, the odds of choosing planting of different varieties of crops, planting of early maturing crops, uses of fertilizer and irrigation decreases by a factor of 0.284, 0.187, 0.422 and 0.146 for a unit change in extension visit respectively. This is in contrast with existing studies by Nolyn et al. [15], Legesse et al. [32], Mudzonda [33], Deressa [34], Nhemachena and Hassan [23], and Maddison [35] who found that access to extension influenced farmer adaptation, their findings also reveals that access to extension strongly and significantly affect adaptation to climate change.

Access to Credit: Access to credit had strong impact on farmer's willingness to adapt climatic condition. Credit helps farmers to foster their agricultural enterprise and sustaining livelihood under extreme climate. The estimated parameters reveals that access to credit were significant across planting of early maturing crops (-1.766**), uses of multiple improving planting dates (-1.124**), changing of farm size (-1.810***), uses of drought tolerant crops (-1.242*), planting of disease resistant crops (-1.344*), diversifying from farm to off-farm activities (-0.419**) and were statistically significant at 5%, 5%, 1%, 10%, 10% and 5% respectively. This implies that, access to credit had strong and negative influence on farmer's choice of choosing planting early maturing crops, uses of multiple improving planting dates, changing of farm size and uses of drought tolerant crops, planting of disease resistant crops and diversifying from off-farm activities. The exp (β) indicates that, the odds of choosing planting of early maturing crops, uses of multiple improving planting dates, changing of farm size, uses of drought tolerant crops, diversifying from off-farm activities decreases by a factor of 0.171, 0.325, 0.164, 0.289, 0.261 and 0.242 for a unit change in access to credit respectively. These findings disagrees with a study by Caviglia-Harris [36] that access to credit is an important variable which commonly has a positive effect on adaptation behaviours.

Result on access to credit further reveals that, access to credit had positive coefficient across irrigation (1.089*), and were statistically significant at 10%. This implies that access to credit had strong and positive influence on famer's choice of choosing planting of disease resistant crops and irrigation. The exp (β) indicates that, the odds of choosing irrigation increases by a factor of 2.970 for a unit change in access to credit. This is in consistent with the findings of Vogel [37], Caviglia-Harris [36], Nhemachena and Hassan [23], Deressa [13], Gbetibuo [20], Below et al. [12], Faosu-Mensah et al. [38], Gutu et al. [24], Nabikolo et al. [39], Tazeze et al. [40] and Tagel et al. [22] that access to credit is an important variable which commonly has a positive effect on adaptation behaviours. Researchers on adoption of agricultural technologies indicate that there is a positive relationship between the level of adoption and the availability of credit [41].

3.3 Constraints Faced by Smallholder Arable Farmers in Adapting to Climate Change

The relative seriousness of various constraints farmers encountered in the process of adapting to changing climate presented on Table 3 reveals that lack of information on climate change (CEI=562, M=3.51) was ranked as the first most serious problem encountered . Followed by lack of technology necessary for adaptation (CE =537, M =3.36) as second, lack of necessary inputs (CEI=536, M=3.35) ranked third, lack of climate forecasting technology (CEI=527, M=3.29), limited knowledge on adaptation to climate issues (CEI=515, M=3.22), poor financial resource (CEI=503, M=3.14), lack of improved varieties (CEI=501, M=3.13), lack of government policy on climate change (CEI=501, M=3.13), poor potential for irrigation (CEI=486, M=3.05), difficulty in shifting from cropping patterns in short duration (CEI=465,M =2.91), lack of infrastructure (CEI=455,M=2.88), lack of access to extension service (CEI=421, M=2.63), shortage of labour (CEI=418, M=2.61), literacy level (CEI=372, M=2.10), land fragmentation (CEI=294, M=1.89) and traditional belief (CEI=284, M=1.78) was ranked as fourteenth and the least constraints encountered while adapting to climate related extremes in the study area. This finding is in line with previous research reports that inadequate funding, lack of information on climate change, poor potential for irrigation, shortage of labour were major factors that hindered farmers adapting to climate change [42]. Similar findings has been reported in previous studies, the researchers reported that lack of weather information, poor access to technology necessary for adaptation, lack of access to extension services, lack of appropriate technology, lack of necessary inputs, lack of labour, absence government policy on climate change, limited knowledge on adaptation measure, limited access to improved crop varieties, lack of weather forecasting technologies, low level of literacy, small land holdings, traditional belief and lack of technical know-how on climate change [43,44,45,46].

Table 2. Logit regression analysis of factors influencing farmer's adaptation measures

Variable	Planting of different varieties of crops	Planting early maturing crops	Use of multiple improving planting date	Tillage	Mixed farming	Changing of planting and harvesting dates	Mulching	Changing of farm size	Use of drought tolerant crops	Planting of disease resistant crops	Planting ahead of rain fall	Use of fertilizer	Irrigation	Drainage	Deeper planting than usual	Diversifying from farm to off-farm activities
Intercept	-2.979* (-) [0.075]	-3.170** (-) [0.041]	3.324*** (-) [0.007]	-1.513 (-) [0.193]	-28.323*** (-) [0.000]	2.300** (-) [0.051]	-2.723* (-) [0.078]	1.076 (-) [0.366)	-0.656 (-) [0.592]	-4.494*** (-) [0.003]	-1.376 (-) [0.312]	-2.488* (-) [0.097]	-1.861 (-) [0.152]	1.470 (-) [0.335]	3.455** (-) {0.012]	0.384 (-) [0.737]
Age	0.006 (1.006) [0.840]	0.020 (1.020) [0.416]	-0.048** (0.953) [0.027]	0.010 (1.010) [0.621]	0.097 (1.102) [0.112]	-0.041** (0.960) [0.052]	0.004 (1.004) [0.879]	-0.026 (0.974) [0.226]	0.011 (1.011) [0.614]	0.052** (1.053) [0.033]	0.036 (1.037) [0.130]	0.039 (1.039) 0.135]	0.055** (1.056) [0.019]	0.012 (1.012) [0.670]	-0.043* (0.958) 0.079]	-0.004 (0.996) [0.849]
Education	0.012 (1.012) [0.815]	0.040 (1.041) [0.417]	-0.097** (0.908) [0.021]	0.076** (1.079) [0.059]	0.078 (1.081) [0.466]	-0.093** (0.911) [0.025]	0.017 (1.018) [0.728]	-0.044 (0.957) [0.286]	-0.047 (0.954) [0.267)	0.069 (1.071) [0.157]	0.052 (1.054) [0.265]	0.032 (1.033) [0.516]	0.094** (1.098) [0.046]	0.010 (1.011) [0.847]	-0.035 (0.966) [0.455]	-0.014 (1.014) [0.722]
Gender	1.003 (2.727) [0.168]	1.267** (3.549) [0.050]	-0.169 (0.844) [0.722]	0.154 (1.167) [0.736]	-0.637 (0.529) [0.579]	-0.272 (0.762) [0.547]	1.719** (5.580) [0.022]	-0.969** (0.380) [0.034]	0.980* (2.663) [0.057]	1.108** (3.028) [0.053]	0.283 (1.327) [0.631]	0.234 (1.263) [0.710]	0.587 (1.799) [0.221]	-1.554** (0.211) [0.033]	-0.554 (0.575) [0.328]	-1.592*** (0.203) [0.002]
Marital Status	0.893** (2.442) [0.039]	0.398 (1.489) [0.333]	0.013 (1.013) [0.972]	0.237 (1.268) [0.487]	0.550 (1.739) [0.448]	0.578 (1.783) [0.110]	0.770* (2.160) [0.075]	0.037 (1.038) [0.916]	0.096 (1.100) [0.800]	0.676 (1.966) [0.104]	0.224 (1.251) [0.589]	-0.090 (0.914) [0.837]	-0.091 (0.913) [0.813]	-0.385 (0.681) [0.419]	0.196 (1.217) [0.648]	-0.300 (0.741) [0.398]
Household size	-0.154 (0.857) [0.657]	-0.547* (0.578) [0.092]	-0.828** (0.437) [0.004]	-0.039 (0.962) [0.884]	-1.573 (0.207) [0.049]	-0.295 (0.745) [0.302]	-0.376 (0.686) [0.251]	0.281 (1.325) [0.319]	-0.684** (0.504) [0.019]	-0. 495 (0.609) [0.131]	0.466 (1.594) [0.152]	0.031 (1.031) [0.926]	0.058 (1.060) [0.847]	0.318 (1.375) [0.408]	-0.735** (0.480) [0.027]	-0.132 (0.876) [0.626]
Farming Experience	-0.503 (0.695) [0.400]	-0.402 (0.669) [0.451]	-0.018 (0.982) [0.968]	0.586 (1.797) [0.181]	1.008 (2.740) [0.440]	-0.102 (0.903) [0.819]	-0.237 (0.789) [0.666]	-0.152 (0.859) [0.744]	-0.430 (0.651) [0.364]	-0.652 (0.521) [0.209]	-0.896* (0.408) [0.093]	-0.238 (0.788) [0.667]	0.378 (1.459) [0.983]	-0.907 (0.404) [0.134]	-0.378 (0.685) [0.451]	-0.129 (0.879) [0.769]
Farm size	0.441 (1.558) [0.436]	1.125** (3.081) [0.031]	1.123** (3.075) [0.011]	-0.144 (0.866) [0.725]	0.687 (1.988) [0.582]	0.434 (1.544) [0.301]	0.167 (1.182) [0.755]	0.244 (1.276) [0.566]	-0.301 (0.740) [0.507]	0.054 (1.055) [0.917]	-0.214 (0.807) [0.664]	-0.012 (0.989) [0.982]	-0.010 (0.990) [0.983]	1.165** (3.207) [0.059]	1.899*** (6.679) [0.001]	0.636 (1.889) [0.129]
Soil fertility	0.444 (0.185) [0.358]	0.304 (1.355) [0.482]	0.036 (1.037) [0.922]	0.247 (1.280) [0.479]	1.309 (3.702) [0.217]	-0.317 (0.728) [0.379]	0.589 (1.802) [0.192]	0.310 (1.364) [0.386]	1.044*** (2.840) [0.007]	1.467*** (4.335) [0.001]	-0.899** (0.407) [0.042]	-0.054 (0.948) [0.904]	0.253 (1.288) [0.514]	0.916* (2.499) [0.091]	0.226 (1.254) [0.604]	0.711** (2.036) [0.052]

Variable	Planting of different varieties of crops	Planting early maturing crops	Use of multiple improving planting date	Tillage	Mixed farming	Changing of planting and harvesting dates	Mulching	Changing of farm size	Use of drought tolerant crops	Planting of disease resistant crops	Planting ahead of rain fall	Use of fertilizer	Irrigation	Drainage	Deeper planting than usual	Diversifying from farm to off-farm activities
Cooperative	-1.688** (0.284) [0.050]	-0.091 (0.913) [0.880]	0.097 (1.101) [0.844]	-1.028** (0.358) [0.032]	1.568 (4.798) [0.206]	1.168** (3.216) [0.019]	-2.239*** (0.107) [0.007]	0.169 (1.184) [0.19]	-0.779 (0.459) [0.124]	-1.764*** (0.171) [0.003]	-2.508*** (0.081) [0.000]	-1.089 (0.336) [0.126]	-1.113** (0.328) [0.032]	-0.989 (2.372) [0.130]	-0.116 (0.891) [0.831]	0.254 (1.289) [0.602]
Extension contact	-1.257** (0.356) [0.022]	-1.675*** 0.187) [0.001]	0.028 (1.029) [0.950]	-0.523 (0.593) [0.236]	17.663 (4.687E7) [-]	-0.488 (0.614) [0.279]	-1.305** (0.271) [0.012]	-0.168 (0.845) [0.711]	-0.307 (0.736) [0.513	-0.871* (0.418) [0.092)	0.153 (1.165) [0.764]	-0.862* (0.422) [0.092]	-1.922*** (0.146) [0.002]	-0.520 (0.594) [0.455]	-0.905 (0.405) [0.122]	0.275 (1.316) [0.537]
Credit	-1.032 (0.753) [0.386]	-1.766** (0.171) [0.052]	-1.124** (0.325) [0.042]	-0.284 (0.753) [0.606]	-1.175 (0.309) [0.401]	-0.535 (0.586) [0.311]	0.367 (1.444) [0.680]	-1.810*** (0.164) [0.005]	-1.242* (0.289) [0.067]	-1.344* (0.261) [0.079]	-1.192 (0.304) [0.196]	-0.730 (0.482) [0.427]	1.089* (2.970) [0.064]	0.268 (1.308) [0.699]	-0.752 (0.472) [0.195]	-0.419** (0.242) [0.011]
Chi-square	28.128***	35.262***	34.697***	18.784*	16.435**	26.167***	37.202***	26.193***	36.675***	65.916*	61.886***	17.069*	40.113***	16.177**	33.696***	26.808***
Cox and Snell	0.161	0.198	0.195	0.111	0.098	0.151	0.207	0.151	0.205	0.338	0.321	0.101	0.222	0.096	0.190	0.154
Nagelkerte	0.274	0.299	0.269	0.149	0.323	0.203	0.319	0.208	0.281	0.458	0.445	0.165	0.304	0.163	0.272	0.206
McFadden	0.198	0.204	0.157	0.086	0.286	0.121	0.221	0.126	0.175	0.309	0.302	0.113	0.191	0.114	0.176	0.121

*Source: Field survey, 2016 Exp(β) and significance level were given in parentheses. ***, ** and * = Values statistically significant at 1%, 5% and 10% level of significance respectively*

Table 3. Rank of the constraints faced by the farmers in adapting climate change issues

Constraints	Degree of the constraints					
	Very serious	Serious	Less serious	Not serious	CEI	Rank
Lack of information on climate change	100	43	16	1	562	1st
Lack of technology necessary for adaptation	95	32	28	5	537	2nd
Lack of necessary inputs	85	49	23	3	536	3rd
Lack of climate forecasting technology	88	40	23	9	527	4th
Limited knowledge on adaptation to climate issues	70	60	25	5	515	5th
Poor financial resource	68	57	25	10	503	6th
Lack of improved varieties	74	43	33	10	501	7th
Absent of government policy on climate change	74	45	29	12	501	7th
Poor potential for irrigation	64	50	34	12	486	8th
Difficulty in shifting from cropping patterns in short duration	57	44	46	13	465	9th
Lack of infrastructure	58	45	33	22	455	10th
Lack of access to extension service	45	41	44	30	421	11th
Shortage of labour	29	52	67	12	418	12th
Literacy level	16	42	44	58	372	13th
Land fragmentation	11	21	59	69	294	14th
Traditional belief	11	13	65	71	284	15th

Source: Field survey, 2016

4. CONCLUSION

The study concludes that various socio-economic and personal attributes had substantial impacts on arable farmer's choice of adapting to different adaptation measures available in the study area.The socio-economic and personal attributes influencing arable farmers' choice of adaptation measures as revealed by the study include; age, education status, gender, marital status, household size, farming experience, farm size, fertility of the soil, membership of cooperative/farmers groups, extension contact and access to credit. The study recommended that government should place priority on determining factors of adaptation and barriers to adaptation measure into climate change-related policies.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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