Farmers' strategies for adapting to climate change in Ogbomoso agricultural zone of Oyo state

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Abstract

The climate is changing and global mean temperatures have increased this is expected to have profound effects on food security. Long-term changes in climate will disproportionately affect tropical regions, meaning poor farmers in Sub-Saharan Africa will likely bear the brunt of adverse impacts. Adaptation plays an important role in reducing vulnerability to climate change and is therefore critical and of concern in developing countries, particularly in Africa where vulnerability is high because ability to adapt is low. This study examined farmers' strategies for adapting to climate change in Ogbomoso agricultural zone of Oyo State of Nigeria. One hundred and fifty farmers were interviewed to obtain information from using a multi-stage sampling procedure. The results of the study showed that the types of climate change identified in the study area were delayed on-set of rainfall (38.0 percent), higher temperature (20.0 percent) and less rain (17.3 percent). The outcome of climate change were food shortage (41.3percent), decline in livestock yield (30.7 percent), decline in crop yield (28.7 percent) and death of livestock (16.0 percent). The identified actions taken to address climate change are growing a new crop (57.4 percent), adoption of drought tolerant/ resistance crop varieties (50.0 percent), diversification from crops to livestock production (40.7 percent) and using of new land management practices. The long-term improvement investments commonly adapted in the study area were tree planting/agroforestry, mulching/surface cover, improved fallowing and fallowing.

The study concluded that household size, extension visits and non-farm income significantly impact on the various strategies used in adaptation to climate change.

Key words

Climate, probit, mulchin, adaptation.

Introduction

Climate is an important factor of agricultural productivity. Given the fundamental role of agriculture in human welfare, concern has been expressed by Federal agencies and others regarding the potential effects of climate change on agriculture productivity in Nigeria. Climate change is a phenomenon due to emissions of greenhouse gases from fuel combustion, deforestation, urbanization and industrialization (Upreti, 1999) resulting in variations in solar energy, temperature and precipitation. Climate change can seriously affect agricultural production and therefore, food security (availability of food). Nigeria, at present does not enjoy food security, hence, is very vulnerable to the effects of climate change. Climate change affects agriculture in a number of ways. Extreme weather events such as thunderstorms, heavy winds, and flood devastate farmlands and can lead to crop failure. Pests and crop diseases migrate in response to climate variation (e.g. the tsetse fly has extended its range northward) and will potentially pose a threat to livestock in the drier northern areas.

The most devastating adverse impacts of climate change in Nigeria and other subtropical countries includes frequent drought, increased environmental damage, increase infestation of crop by pests and disease, depletion of household assets, increased rural urban migration, increased biodiversity loss, increased health risks and the spread of infectious diseases, changing livelihood systems e.t.c (Reilly, 1999; Abaje and Giwa, 2007).

Studies indicate that Africa's agriculture is negatively affected by climate change (Pearce et al., 1996; McCarthy et al., 2001). Adaptation is one of the policy options for reducing the negative impact of climate change (Adger et al., 2003; Kurukulasuriya and Mendelsohn, 2008). Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2001). Common adaptation methods in agriculture include use of new crop varieties and livestock species that are better suited to drier conditions, irrigation, crop diversification, adoption of mixed crops and livestock farming systems, and changing planting dates (Bradshaw et al., 2004; Nhemachena and Hassan, 2007).

Although African farmers have a low capacity to adapt to such changes, they have, however, survived and coped in various ways over time. Better understanding of how they have done this is essential for designing incentives to enhance private adaptation.

Agriculture in Nigeria is a major economic sector contributing about 30 – 40% of the nations GDP. More than 70% of the population of the country depends on agricultural sector for their livelihood. Despite its high contribution to the overall economy, this sector is challenged by many factors of which climate – related disasters like drought and flood are the major ones (Deressa, 2007).

Studies have been undertaken to analyze the impact of climate change and factors affecting the choice of adaptation methods in crop, livestock and mixed crop livestock production systems in Africa at regional level. (Maddison, 2006; Kurukulasuriya and Mendelsohn, 2008; Seo and Mendelsohn, 2008; Hassan and Nhemachena, 2008) and findings showed these studies are highly aggregated and the parameter estimates have little importance in identifying country specific impacts and adaptation methods given the heterogeneity of countries included.

Therefore, the objective of this study is to analyze farmers' strategies for adapting to climate change in Ogbomoso Agricultural Zone of Oyo State, Nigeria.

Material and Methods

The study was carried out in Ogbomoso agricultural zone of Oyo State, Nigeria. There are five local government areas in this zone namely: Ogbomoso North, Ogbomoso South, Ogo-oluwa, Surulere and Oriire local governments.

The population of the study comprises all registered farmers with the State Agricultural Development Programme in the study area. A multistage random sampling procedure was used to select the respondents. The first stage involves purposive selection of three out of the five local government areas with rural outlook. Second stage involves the random selection of five villages in each local government area making a total of fifteen (15) villages. The last stage involves random selection of ten (10) farmers from each village making a total of one hundred and fifty farmers (150). Data were collected with the aid of a questionnaire. The analytical techniques employed include descriptive statistics and multinomial logit model.

Adaptation measures help farmers guard against losses due to increasing temperatures and decreasing precipitation. The analyses presented in this study identify the important determinants of adoption of various adaptation measures to provide policy information on which factors to target and how, so as to encourage farmers to increase their use of different adaptation measures. The analytical approaches that are commonly used in an adoption decision study involving multiple choices are the multinomial logit (MNL) and multinomial probit (MNP) models. Both the MNL and MNP are important for analyzing farmer adaptation decisions as these are usually made jointly. These approaches are also appropriate for evaluating alternative combinations of adaptation strategies, including individual strategies (Hausman and Wise, 1978; Wu and Babcock,1998). This study used a MNL logit model to analyze the determinants of farmers' decisions because it is widely used in adoption decision studies involving multiple choices and is easier to compute than its alternative, the MNP.

The advantage of using a MNL model is its computational simplicity in calculating the choice probabilities that are expressible in analytical form (Tse, 1987). This model provides a convenient closed form for underlying choice probabilities, with no need of multivariate integration, making it simple to compute choice situations characterized by many alternatives. In addition, the computational burden of the MNL specification is made easier by its likelihood function, which is globally concave (Hausman and McFadden, 1984). The main limitation of the model is the independence of irrelevant alternatives (IIA) property, which states that the ratio of the probabilities of choosing any two alternatives is independent of the attributes of any other alternative in the choice set (Hausman and McFadden, 1984; Tse, 1987).

Let Ai be a random variable representing the adaptation measure chosen by any farming household. The study assumed that each farmer faces a set of discrete, mutually exclusive choices of adaptation measures. These measures are assumed to depend on a number of climate attributes, socioeconomic characteristics and other factors X. The MNL model for adaptation choice specifies the following relationship between the probability of choosing option Ai and the set of explanatory variables X as (Greene, 2003):

$$\text{Prob}(Ai=j)= \frac{e^{\beta_j^i x_i}}{\sum_{k=0}^{i} e^{\beta_j^i x_i}} \text{ , j = 1,1…..J} \quad (1)$$

where β_j is a vector of coefficients on each of the independent variables X. Equation (1) can be normalized to remove indeterminacy in the model by assuming that $\beta_0=0$ and the probabilities can be estimated as:

$$\text{Prob}(Ai=j/xi)= \frac{e^{\beta_j^i x_i}}{1+\sum_{k=0}^{i} e^{\beta_j^i x_i}} \text{ , j = 0,1..J, } \beta 0 = 0 \quad (2)$$

Estimating equation (2) yields the J log-odds ratios

$$\text{In}\left(\frac{P_{ij}}{P_k}\right) = x_j^i(\beta_j - \beta_k) = x_j^i \beta_j, \text{f } k = 0 \quad (3)$$

The dependent variable is therefore the log of one alternative relative to the base alternative.

The MNL coefficients are difficult to interpret, and associating the β_j. with the jth outcome is tempting and misleading. To interpret the effects of explanatory variables on the probabilities, marginal effects are usually derived as (Greene, 2003):

$$\delta_j = \frac{\partial P_j}{\partial x_i} = P_j\left[\beta_j - \sum_{k=0}^{j} P_k \beta_k\right] = P_j(\beta_j - \bar{\beta}) \quad (4)$$

The marginal effects measure the expected change in probability of a particular choice being made with respect to a unit change in an explanatory variable (Long, 1997; Greene, 2000). The signs of the marginal effects and respective coefficients may be different, as the former depend on the sign and magnitude of all other coefficients.

Characteristics	Mean	Frequency of class	Percentage distribution
Age(year)	46.8	11	7.3
Gender	-	122	81.3
Marital Status	-	128	85.3
Religion	-	97	64.7
Household Size	6.85	27	18.0
Education(years)	8.66	83	55.3
Experience (years)	23.68	25	16.7
Farm size	4.13	41	27.3
Extension Visit	-	129	86.0

Source: Field survey, 2010

Table1: Summary of socio economic characteristics.

Variables	Mean	Standard Deviation	Description
Age of the household head	46.79	10.80	Continuous
Household size	6.85	2.63	Continuous
Years of education	8.66	4.74	Continuous
Gender of the household head	-	-	Dummy, takes the value of 1 if male and 0 otherwise
Farm size (Hectare)	4.13	3.42	Continuous
Farming experience	23.68	12.56	Continuous
Extension visit	-	-	Dummy, takes the value of 1 if visited and 0 otherwise
Information on climate change	-	-	Dummy, takes the value of 1 if thereis and 0 otherwise
Years of using adaptation options	0.88	4.56	Continuous
Non Farm income	6665.00	8817.11	Continuous
Livestock ownership	-	-	Dummy, takes the value of 1 if owned and 0 otherwise

Source: Field survey, 2010

Table 2: Description of the variables used in the empirical analysis.

Results and Discussion

Type of Climate Experienced by the Respondents

Table 3 shows some of the climate change experienced by the respondents. Some of the changes are more frequent drought, delayed on – set of rainfall, too much rain, higher temperature and so on. The result reveals that 38% of the respondents observed delayed on – set of rainfall which has led to the importance and necessity of irrigation practice in the area in order to improve and maintain high output. The result also shows that 22% of the respondents observed earlier on-set of rainfall while 20% and 17.3% observed higher temperature and less rain respectively.

Type of climate change	Frequency	Percent (%)
More frequent drought	17	11.3
Delayed on – set of rainfall	57	38.0
Erratic rainfall pattern	19	12.7
Too much rain	4	2.7
Low rain	26	17.3
Higher temperature	30	20.0
Earlier on – set of rainfall	18	22

Source: Field survey, 2010. Response>150 due to multiple choice response

Table 3: Type of climate change.

Result of Climate Change Noticed by the Re spondents

It was observed that the climate change noticed by the respondents brought about some changes in crop and livestock production. Some of the consequences of the climate change were decline in crop yield (28.7%), decline in livestock yield (30.7%), increase in crop yield (16%), increase in livestock production (8%) and death of livestock (16%). Majority of the respondents which are 41.3% noticed a food shortage since the climate is no longer favourable for planting condition which the majority is into.

Result of climate change	Frequency	Percent (%)
Decline in crop yield	43	28.7
Decline in livestock yield	46	30.7
Increase in crop yield	24	16
Increase in livestock production	12	8
Death of Livestock	24	16.0
Food shortage /insecurity	62	41.3
Food price increase	12	8.0

Source: Field, 2010. Response>150 due to multiple choice response

Table 4: Result of climate change.

Most affected in the household by climate change

Those there were mostly affected by the climate change was examined and it was observed that all the household members were affected but with varied degree since it had to do with reduction of productivity which led to reduction of income level of the respondents. As it is shown in table 5, some respondents felt it affected children and women with the least likelihood of elderly as the culture of taking care of the aged is well entrenched in the area.

Action Taken By Respondent to Address Climate Change

Response of farmers to climate change was examined and as noted in Table 6 reveals that majority (57.4%) of the respondents started growing new crops which could adapt to the present climate in order to increase productivity. Others went into adopting of drought tolerant crops (50%), some moved focus from crop to livestock production (40%), 22% started new land management practices, 16% started non-farm activities while 6% did nothing to address the change in climate.

Most affected	Frequency	Percent (%)
Children	9	6.0
Women	4	2.7
Men	2	1.3
Elderly	1	0.7
All	134	89.3

Source: Field survey, 2010.

Table 5: Most affected in the household.

Action taken	Frequency	Percent (%)
Did nothing	9	6.0
Started growing new crops	86	57.4
Adopted drought tolerant/		
Resistance crop varieties	75	50.0
Moved focus from crops to livestock production	61	40.7
Started non – farm activities	24	16.0
Started using new land management practices	33	22.0
Received food aid	1	0.7
Bought food	8	5.3
Ate less	1	0.7
Ate different foods	14	9.3

Source: Field survey, 2010. Response>150 due to multiple choice response

Table 6: Action taken by respondents.

Type of Long Term Improvement Investment Practiced by the Respondents

It was observed that respondents took to long term improvement investment practice which is a practice which would improve or enhance productivity over a long period of time. Most of the respondents (28%) went into tree planting and agroforestry as a long term practice. It served as dual purpose(the cultivation of the trees crops such as oranges, mangoes and so on) and as a cover crops in shielding shrubs and herbs thereby protecting the soil from erosion and increasing fertility of the soil. The other long term improvement investment adapted in the study area were mulching/ surface cover(16%), improved fallowing(10%), fallowing(8%), infiltration ditches(7.3%) and ridge and furrow (7.3%)

Long term investment	Frequency	Percent (%)
Soil bunds	7	4.7
Bench terraces	9	6
Mulching	24	16
Grass strips	9	6
Hedge rows (Shrubs)	2	1.3
Tree planting/agroforestry	42	28
Infiltration ditches	11	7.3
Ridge & Furrow	11	7.3
Fallowing	12	8
Improved fallowing	15	10
Water harvesting	9	6

Source: Field survey, 2010. Response>150 due to multiple choice response

Table 7: Type of long – term improvement investment.

2.6 Previous Land Long Term Improvement Investment Used By Respondents

Before the long term improvement practice used by the respondents most of them has previous practice which the climate then could promote leading to increase in yield. Some of the practices used then were tree planting/agroforestry (28%), hedge rows (18%), mulching and surface cover (15.3%), stone bunds (4.7%). The survey implies that most of the respondents (28%) were previously into fallowing which was common and widely used and also climate favoured the practice then.

Previous practice	Frequency	Percent (%)
Bench Practice	6	4.0
Stone bunds	7	4.7
Mulching/surface cover	23	15.3
Woodlots	1	0.7
Hedge rows	27	18
Tree planting/agroforestry	4	2.7
Infiltration ditches	6	4.0
Ridge & furrow	6	4.0
Fallowing	42	28.0
Improved fallowing	5	3.3
Water harvesting	1	0.7

Source: Field survey, 2010.

Table 8: Previous practiced used by respondents.

Initial Reason for Change in Land Improvement Practice

There were various reasons why most of the respondents changed from previous land improvement practice to another improvement practice. Some of the reasons were to increase productivity (64%), increase water holding capacity(12.7%), response to climate change(10%) and to reduce erosion(8.7%).

Reason for change	Frequency	Percent (%)
To increase productivity	96	64
To increase water holding capacity	19	12.7
To increase soil fertility	7	4.7
To reduce erosion	13	8.7
To response to climate change	15	10.0
Total	150	100.0

Source: Field survey, 2010.

Table 9: Initial reasons for change in land practice.

Management Technique Used by the Respondents for Grazing

Some of the respondents' are into rearing of animal alongside crop farming. It was observed from the field survey that majority (55.3%) used removal of unwanted bush as management technique for grazing in order to reduce the risk of livestock coming in contact with harmful micro organisms and pests which could reduce the health of the animals leading to high expenses incurred to take care of the ill animals. The ill livestock if not taken care of could die thereby increasing loss or reduction in profit margin of the farmers. The other management techniques use for grazing are periodic resting(17.3%), free range (9.3%), enclosure of land (7.3%) and so on.

Previous Management Technique for Grazing Used By Respondents

Table 11 reveals that before the respondents went into removal of unwanted bush around their livestock, majority of the respondents (86.7%)

Management techniques used	Frequency	Percent (%)
Enclosure of land	11	7.3
Restriction or livestock numbers (destroying)	2	1.3
Maintaining large stocks	7	4.7
Removal of unwanted bush	83	55.3
Periodic resting	26	17.3
Open grazing area	4	2.7
Free range grazing	14	9.3
Common watering point	3	2.0

Source: Field survey, 2010.

Table 10: Management techniques used for grazing land.

Previous management techniques	Frequency	Percent (%)
Enclosure of land	51	34
Restriction or livestock numbers (destroying)	2	1.3
Removal of unwanted bush	7	4.7
Periodic resting	1	0.7
Open grazing area	6	4
Free range grazing	130	86.7
Common watering point	1	0.7

Source: Field, 2010. Response>150 due to multiple choice response

Table 11: Previous management technique used.

were into free range grazing practice because of the low capital and labour requirement.

Multinomial Logit Model

The estimation of the multinomial logit model for this study was undertaken by normalizing one category, which is normally referred to as the "reference state," or the "base category." In this analysis, the first category (no adaptation) is the reference state. The estimated coefficients of the MNL model, along with the levels of significance, are presented in Table 12. The likelihood ratio statistics as indicated by $\chi 2$ statistics are highly significant ($P < 0.02881$), suggesting the model has a strong explanatory power. As indicated earlier, the parameter estimates of the MNL model provide only the direction of the effect of the independent variables on the dependent (response) variable: estimates do not represent actual magnitude of change or probabilities. Thus, the marginal effects from the MNL, which measure the expected change in probability of a particular choice being made with respect to a unit change in an independent variable, are reported and discussed. In all cases the estimated coefficients should be compared with the base category of no adaptation. Table 13 presents the marginal effects along with the levels of statistical significance.

Age of the household head

Age of the household head affected adaptation to climate change. Age of the farmer did not seem to be of significant in influencing adaptation, as almost all marginal effect coefficients were statistically insignificant and their signs do not suggest any particular pattern. This finding followed the intuitive position as it is expected that the household head age will be closely related to the experience of how climate change overtime

Household Size

For most of the adaptation methods, increasing household size did not significantly increase the probability of adaptation, through the coefficient on the adaptation option has a positive sign and only significant in adoption of drought tolerant crop varieties. This implies that large families are able to adopt drought tolerant crop varieties whereas the smaller ones tend to adapt to nothing (no adaptation).

3.3 Education

Education of household head increases the probability of adapting to climate change. From table13 education significantly increases adopting drought tolerant crop varieties and using of new land management practices. . A unit increase in number of years of schooling would result in a 0.3% increase in the probability of adopting drought tolerant crop varieties and a 0.8% increase in change in using of new land management practices.

3.4 Gender of the household head

The results indicate that male – headed household are more likely to adopt drought tolerant crop varieties and less likely to grow new crops and use new land management practices. Male – headed households were 34.1% more likely to adopt drought tolerant crop varieties and 22.9% and 11.5% less likely to grow new crop and use new land management practices respectively. The possible reason for this is that much of the farming activities are done by male while female are more involved in the processing, this will give male an edge in terms of farming experience and information on various management practices and what needed to be done in response to the climatic instability.

3.5 Farm size

Larger farm sizes appear to be associated with adopting of drought tolerant crop varieties and moment of focus from crop to livestock. Larger farm sizes reduce the probability of growing new crops but increases the probability of adopting drought tolerant crop varieties and moving of focus from crop to livestock production.

3.6 Experience

The more experienced farmers are more likely to adapt to drought tolerant crop varieties than the less experienced. A unit increase in the years of experience would result in a 1.2% increase in the probability of adopting drought tolerant crop varieties.

3.7 Years of using adaptation options

Farmers with more years of using adaptation options are more likely to adapt to growing of new crops and using of new land management practices. Farmers with more years of using adaptation option are less likely to adopt drought tolerant crop varieties.

3.8 Extension visit

Having access to extension visit increases the likelihood of adopting drought tolerant crop varieties and reduces the likelihood of using new land management practices.

3.9 Information on climate change

Farmer that has information on climate change (temperature and rainfall) has a significant and positive impact on the likelihood of adopting

Explanatory variable	Growing of new crops	Adopted drought tolerant/ resistant crop varieties	Moved focus from crop to livestock	Using of new land management practice
Constant	5.021(1.984)**	3.301(1.272)	5.011(1.932)*	2.950(1.013)
Age	-0.014(2.014)**	-0.025(-1.903)*	0.019(0.560)	-0.011(-0.284)
Household size	0.404(2.592)***	0.393(1.942)**	0.279(1.647)*	0.357(1.683)*
Education	-0.068(-0.842)	-0.0063(-0.720)	0.080(1.936)*	0.005(2.053)**
Gender	0.570(2.631)***	0.927(0.871)	0.057(0.057)	-0.793 (-0.844)
Farm size	0.085(2.131)**	0.058(0.413)	-0.154(-1.844)*	-0.027(-0.195)
Experience	-0.025 (-0.618)	-0.029(-1.708)*	0.006(0.154)	0.035(1.797)*
Extension	-1.606(-2.377)**	-1.293(-1.063)	-31.522(-26.897)***	-2.544(-2.018)
Years of practice	0.77(0.995)	-0.040(-0.474)	0.103(2.137)**	0.105(1.244)
Information	0.601(0.540)	0.189(0.160)	-0.461(-0.399)	-0.575(-2.482)**
Nonfarm income	0.029(2.608)***	0.011(2.367)**	0.071(1.436)	0.092(1.826)*
Livestock ownership	-3.615(-4.011)***	-3.542(-3.529)***	-4.007(-4.178)***	-3.197(-3.017)***
Diagnostic				
Base category		**No Adaptation**		
Number of observation		**150**		
Chi-square		**63.465*** **		
Log likelihood		**-190.091**		

Table 12: Parameter estimates of the multinomial logit model.

Explanatory variable	Growing of new crops	Adopted drought tolerant/ resistant crop varieties	Moved focus from crop to livestock	Using of new land management practice	No Adaptation
Constant	0.492(1.499)	0.492(1.499)	0.006(0.790)	-0.164(-0.642)	-0.109(-1.391)
Age	0.001(0.183)	0.001(0.183)	-0.001(-2.081)**-	0.009(2.213)**	0.005(0.515)
Household size	0.011(0.400)	0.011(0.400)	0.006(-1.050)	0.004(0.162)	-0.010 (-1.879)*
Education	-0.006(-0.578)	-0.006(-0.578)	-0.02(-0.562)	0.008(2.020)**	0.002(0.689)
Gender	-0.229(-2.539)**	-0.229(-2.539)**	0.008(0.231)	-0.115(-1.933)*	0.002(0.093)
Farm size	-0.028(-1.879)*	-0.028(-1.879)*	0.007(1.688)*	-0.003(-0.030)	0.007(0.198)
Experience	0.001(0.247)	0.001(0.247)	0.012(2.248)**	-0.013(-0.398)	0.007(0.665)
Extension	0.082(0.546)	0.082(0.546)	-0.173(-4.755)	-0.123(-1.768)*	0.049(1.993)**
Year of practice	0.017(1.644)*	0.017(1.644)*	0.004(1.193)	0.010(2.471)**	-0.001(-0.510)
Information	-0.135(-2.225)**	-0.135(-2.225)**	-0.009(-0.318)	-0.042(-0.522)	0.009(0.301)
Non – farm income	-0.018(-2.724)***	-0.018(-2.724)***	0.002(0.139)	0.004(1.103)	-0.019(-2.434)**
Livestock ownership	-0.089(-0.773)	-0.089(-0.773)	-0.003(-2.372)**	0.037(0.414)	0.94(2.193)**

***,**,* significant at 1%, 5% and 10% probability level respectively

Table 13: Marginal effect from multinomial logit model.

drought tolerant crop varieties. It increases the likelihood of adopting drought tolerant crop varieties by 16.9%.

3.10 Non – farm Income

Non – farm income significantly increases the likelihood of adapting to drought tolerant crop varieties. A unit increase in non farm income increases the probability of adopting drought tolerant crop varieties by 0.2%. Non farm income showed a negative relationship with the growing of new crops.

3.11 Livestock Ownership

The ownership of livestock is negatively and significant related to movement of focus from crop to livestock.

Conclusion, Policy and Recommendation

This study analyzed the strategies use by farmers for adopting to climate change based on a cross-sectional survey of 150 farming households from Ogbomoso agricultural zone of Oyo State, Nigeria. The main practices actually followed by farmers during the survey year (2010) are mostly taken in combination with other measures and not alone. The different combinations of measures and practices are grouped into four major adaptation options: growing of new crops, adoption of drought tolerant crop varieties, movement of focus from crop to livestock production and using of new land management practices.

A multinomial discrete choice model was used to analyze the determinants of farm-level adaptation measures. The marginal effects from the MNL, which measure the expected change in probability of a particular choice being made with respect to a unit change in an independent variable, were presented for their ease of interpretation. The results from the marginal analysis indicate that household characteristics such as age, education, household size and nonfarm incomes which could be enhanced through policy intervention have significant impact on adaptation to climate change. Thus, investment in education systems, sufficient input supply which increases farm income and creation of off-farm employment opportunities in the rural areas can be underlined as a policy option in the reduction of the negative impacts of climate change. The study further revealed that institutional factors such as extension on crop and livestock production and access to information on climate change enhanced adaptation to climate change. Consequently, policies aiming at promoting adaptation to climate change need to emphasize the crucial role of providing information on better production techniques and on climate change (through extension) to enable farmers adapt to climate change.

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