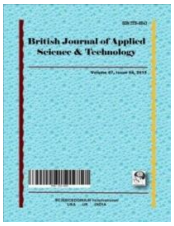

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The Perception and Adaptation Strategies to Climate Change by Rice Farmers in Ekiti State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors KEO and KUJ designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors OVA and FIW managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The study examined the perception and adaption of rice farmers to climate change in Ekiti State, Nigeria. Three Local Government Areas were purposively selected based on level of rice production in Ekiti. Well-structured and pre- tested interview schedule was used to collect relevant information from ninety respondents. Analysis was carried out using descriptive and inferential statistics. The study showed that majority of the respondents were married (85.6%) and the mean age was 50 years. Also, they were mostly males (81.1 percent) practicing farming as primary occupation (78.9%) and had secondary education (91.1%). Major source of information was from friends and family. The study established that the respondents were very much aware of the fact that climate is changing and their level of perception varies. Intensive manure application, introduction of new variety of same crop and increased weeding were the mostly adopted coping strategies with the mean of 3.9 respectively. The other identified adopted strategies by respondents in mitigating the effect of climate change to their farms include; moving to a different site, expansion of cultivated land, breeding of heat and drought resistant crop. Study concluded that rice farmers'

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perception affects the adoption strategies and that farmers' perception is affected by their socio-economic characteristics.

Keywords: Nigeria; rice; climate and mitigation.

1. INTRODUCTION

The Intergovernmental Panel on Climate Change [1] reported that worldwide temperatures have increased more than 0.6°C over the past century and it estimated that by 2100, average temperatures will increase by between 1.4 to 5.8°C. High temperatures decrease yield in tropical climate areas [2]. Studies suggest that temperature increase, rising seas and changes in patterns of rainfall and its distribution under global climate changes might lead to substantial modifications in land and water resources for rice production as well as the productivity of rice crops grown in different parts of the world. The emission of methane and nitrous oxide gases from lowland rice production and the deforestation in upland rice production under slash-and-burn shifting cultivation are contributors to global climate changes [3]. Rice is the staple food crop of the world population; rice cultivation is the principal activity and source of income for more than 100 million households in developing countries in Asia, Africa and Latin America [3].

The world population continues to grow steadily, while land and water resources are on the decline Studies on rice productivity under global warming also suggest that the productivity of rice and other tropical crops will decrease as global temperature increases [4]. Climate change affects agriculture in a number of ways, including through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level [5]. In addition to being a significant user of land and consumer of fossil fuel, agriculture contributes directly to greenhouse gas emissions through practices such as rice production and the raising of livestock [6]. [1] reported that the poorest countries would be hardest hit, with reductions in crop yields in most tropical and sub-tropical regions due to decreased water availability, and new or changed insect pest incidence. In Africa and Latin America many rain fed crops are near their maximum temperature tolerance, so that yields are likely to fall sharply for even small climate changes; falls in agricultural productivity of up to 30% over the 21st century are projected.The effect of climate change in farmer's productivity still remains a question to be answered and debated on, hence, the study examined the perception and adaptation strategies to climate change by rice farmers in Ekiti state Nigeria.

1.1 Objectives of the Study

The general objective of the study was to examine the perception and adaptation strategies to climate change by rice farmers in Ekiti state, Nigeria. The specific objectives were to:

i. describe the socio-economic characteristics of respondents in the study area
ii. identify their source of information about climate change
iii. determine the level of awareness about the effects of climate change
iv. determine the extent to which farmers have been affected by climate change
v. determine adaptive strategies that the farmers have adopted in mitigating climate change

1.2 Hypothesis Testing

Ho_1: there is no significant relationship between Socio- Economic Characteristics of the respondents and perception of climate Change.

2. RESEARCH METHODOLOGY

The study was conducted in Ekiti State, Nigeria, lying between latitude 7^0 15^1 and 8^0 7^1 North of the equator and longitude 4^0 47^1 and 5^0 45^1 East of the Greenwich Meridian. It has a mean annual rainfall of about 1400mm and a mean annual temperature of about 27°C. It's vegetation ranges from Rain forest in the south to Guinea savannah in the North with soil largely rich in organic minerals thereby making the state a major producer of both tree and food crops. A well structured interview schedule was employed to collect primary data. A multistage sampling

procedure was used to select respondents for the study. First, three Local Government Areas (LGAs) namely; Irepodun/ifelodun, Ikole and Ekiti East (Isinbode) were purposely selected from the study area based on their volume of rice production in the State. Secondly, two communities were randomly selected from each of the LGAs, making a total of 6 communities with fifteen (15) respondents per community making a total of thirty (30) respondents per Local Government Area with a total of ninety respondents sampled for the study. To ascertain the content appropriateness of the instrument of data collection, face and content validity was carried out by experts in the field to ascertain the content appropriateness of the instrument while test- retest method was used to ascertain the reliability of the measuring instrument. This was done by administering the same set of questionnaire to a particular group of respondents at two times interval in 2 randomly selected communities which are close to the chosen communities for the study. Thereafter the result of the two administrations was correlated and the correlation coefficient was 0.81 which was an indication that the instrument was reliable. Data collected were analyzed using descriptive and inferential statistics (Chi- square and Karl Pearson's coefficient of correlation (r).

3. RESULTS AND DISCUSSION

3.1 Socio-Economic Characteristic of Respondents

The study revealed that the average age of the respondents was 55 years with majority (38.9 percent) of the farmers above 50 years. This implies that the youth in the study area do not engage in farming as much as the older ones and that that rice farmers are getting older; hence replacement by younger ones is needed. The outcome of this study with respect to age was in line with studies that concludes that youth are searching for greener pastures in cities leaving the aged ones to engage in agriculture because they feel farming is full of drudgery and non-lucrative [7]. Findings from the study showed that 81.1 percent of the respondents were males while 18.9 percent were females. This signifies that the males were more prominent in farming activities in the study area. This contradicts the findings of [8], that in some states in Nigeria, rural women have virtually taken over the production and processing of arable crops. Majority of the respondents had formal education (91.1%), only 35.6% completed secondary school while few (6.7%) have attained tertiary education level. This suggests that rice farmers have relatively low educational level, a trend that could negatively impact on the adoption of new technology and strategies to improve their farming activities, as technological change can be achieved through formal education [9].

Table 1 indicates that 85.6 per cent of them were married, 7.8 per cent were single, 6.7 per cent separated. This implies that most of the respondents in the study area were married. The high proportion of married respondents shows that more members of farm family are likely going to be available for rice cocoa production in the study area. This is a development in positive direction because farm family members will be available to assist on the farm and this will help to reduce the money spent on labour to work on the farm. The study reveals that 78.9 per cent of the respondents indicated farming as their primary occupation. This is followed by the artisans who accounted for 8.9 per cent while civil service and trading constituted 7.8 per cent and 4.4 respectively. This implies that majority of the respondents were fully involved in farming. This is in line with the assertion that there is a predominance of farming as the primary occupation of the rural dwellers and over 90% of the food produced in the country comes from the rural sector [10]. The average household size was five persons (5) with majority (51.1%) having between 4-6 persons in the household which equally suggest a readily available family labour for farming activities. This is because the larger the household size of a farmer the more readily available family labour will be for farming activities [7]. The study revealed that majority 98.9 per cent of the respondents were not in any association while 1.1per cent was involved in an association. This implies that majority of the respondents did not subscribe to any form of farmers association. Farmers' should be encouraged to form groups or cooperatives so as to be able to access some benefits such as loan and collective bargaining. It is also necessary to belong to an association in line with [11] who found out that social participation of cocoa farmers through their involvement in farmers' co-operatives enhanced diffusion of information among the farmers, which is a positive development. Also their involvement in social organizations will enhance their access to government assistance in form of loan and other inputs. The study revealed that 58.9 per cent of the respondents had farming experience of more

than 33 years with a mean of 5 persons. This indicated that majority of the respondents were matured and more experienced in farming, and assumed to have a better knowledge and information on changes in climatic conditions. As reported by [12] and also the findings of [13] in a study of adaptation carried out in Southern Africa, experienced farmers have high skills in farming techniques and management and are able to spread risk when facing climate variability. As indicated in the Table, respondents (47.78 percent) with less than two hectares of land were the majority in the while only twenty-one respondents (23.3 percent) have a farm size of at least three hectares. This implies that majority of the respondents are small scale farmers with average of 0.83 hectare of land. Studies on adoption of agricultural technologies indicate that farm size has both negative and positive effects on adoption, showing that the effect of farm size on technology adoption is inconclusive [14]

3.2 Source of Information on Climate Change

The results presented in Table 2, showed that respondents' major sources of information were friends and family (86.7%), radio (85.%t) and agric extension (66.7%) It implies that majority of the respondents received their information through friends and family. Other sources of information include local leaders (55.3%) and television (47.8%). In accordance to [15], sources of information available mostly to cocoa farmers are family and friends, radio, television and nongovernmental organization. He further stated that many organizations expected to provide information on Cocoa Rehabilitation Techniques have a long way to go.

3.3 Level of Awareness on Climate Change

The result in Table 3 shows that the respondents were aware of high sun intensity ($\bar{X}$= 4.00), loss of soil fertility($\bar{X}$=4.00), drying up of streams and rivers ($\bar{X}$=4.00), extreme temperature ($\bar{X}$=4.00), overflowing of rivers with ($\bar{X}$=4.00), fluctuation in rainfall pattern (3.98), increase in weeds ($\bar{X}$ =3.98), long period of dry season ($\bar{X}$=3.97), reduction in farm yield ($\bar{X}$=3.92), heavy winds ($\bar{X}$ =3.91), unusual early rainfall followed by weeks of dryness (X:3.82), increase in involvement of land encroachment ($\bar{X}$ =3.71), erosion and flood ($\bar{X}$ =3.58). This however indicates that the respondents were aware of the fact that climate has changed as compared to the past. These findings agree with [16], who stated that climate change is already being felt and the effects are seen in many ways.

Table 1. Respondent's distribution by socio-economic characteristics

Socio- economic characteristics	Frequency	Percentage	mean
Age (Years)			
20- 29	9	10.0	
30-39	20	22.2	
40-49	26	28.9	
50-above	35	38.9	50
Sex			
Male	73	81.1	
Female	17	18.9	
Marital status			
Single	7	7.8	
Married	77	85.6	
Separated	6	6.7	
Primary occupation			
Farming	71	78.9	
Trading	4	4.4	
Civil service	7	7.8	
Artisan	8	8.9	
Educational status			
Attempted primary school	4	4.4	
Completed primary school	22	24.4	
Attempted secondary school	26	28.9	
Completed secondary school	32	35.6	
Tertiary	6	6.7	
Average household size			
1-3	10	11.1	
4-6	46	51.1	5.0
7-9	33	36.6	
10 and above	1	1.1	
Farming experience (Years)			
1-10	17	18.9	
11-20	13	14.4	
21-30	9	7.8	
31 and above	53	58.9	33
Farm size(Hectares)			
Below 1.00	25	27.78	0.83
1.199	18	20.0	
2.0-2.99	12	13.3	
3.00-3.99	21	23.3	
Above 4.0	14	15.5	
Membership of farmers association			
Yes	1	1.1	
No	89	98.9	

3.4 Perceived Causes of Climate Change

The result in Table 4 shows that the respondents strongly agreed that burning of crop/household waste ($\bar{X}$ =44.80), the use of agrochemicals ($\bar{X}$ =44.73), burning of firewood for cooking ($\bar{X}$ =44.73), burning of fossils from machines ($\bar{X}$ =44.71), gases released from cement production ($\bar{X}$ =4.60), burning of fossil fuel by industries ($\bar{X}$=44.60), and bush burning ($\bar{X}$=4.52) were all responsible for climate change. The farmers also agreed that overgrazing farmland by livestock ($\bar{X}$=4.36), continuous cropping ($\bar{X}$=3.90) and deforestation and indiscriminately cutting down of trees ($\bar{X}$=3.72) lead to climate change. This result agree with the findings of [17], who was of the opinion that due to the causes of climatic changes, there will be reduction in positive effect on agricultural produce and farmers livelihood will be affected negatively especially in subsistence sector.

3.5 Perceived Effects of Climate Change

As shown in Table 5, the respondents were very much affected by insect and pest diseases ($\bar{X}$ =4.00), reduction in farm yields ($\bar{X}$ =3.98), fluctuation in rainfall pattern ($\bar{X}$=3.76) and loss of soil fertility ($\bar{X}$=3.70). The study also showed that 52.2 per cent were much affected by long period of dry season ($\bar{X}$ =3.36), overflowing of streams/rivers ($\bar{X}$ =3.10), extreme temperature ($\bar{X}$=2.78), unusual early rains followed by weeks of dryness ($\bar{X}$=2.37), drought and longer period of dry season ($\bar{X}$ =2.30), high sun intensity ($\bar{X}$=2.22) and delay in onset of rains ($\bar{X}$=2.22). This implies that climate change is real and it is affecting the major source of livelihood of farmers as agricultural production is naturally tied to climatic conditions. These findings agree with [18], who stated that climate change is already being felt and the effects, are seen in many ways. [2] reported that the yield of dry season rice crops in the Philippines decreased by as much as 15 percent for each 1°C increase in the growing season mean temperature.

3.6 Adaptive Strategies Adopted by the Respondents

The Table 6 below shows the adaptive strategies adopted by the respondents. The Table shows that all the respondents (100 per cent) adopted intensive manure application in mitigating the effect of climate change; introduction of new variety of same crop was adopted by 97.8 per cent of the respondents; 64.4 per cent of the respondents adopted switching cropping sequence; 91.1%per cent adopted moving to a different site; 22.2 per cent shifted their harvesting date; 86.7 per cent practiced mixed farming; increased weeding was adopted by 98.9% of the respondents; 8.9 per cent adopted improved irrigation; 41.1per cent adopted rely cropping and inter cropping; multiple cropping was adopted by 83.3 per cent; 7.8 per cent adopted planting deeper than the usual depth; 98.9 per cent expanded their farm land while 82.2 per cent change from production to marketing of agricultural products. This implies that the respondents had to adopt a strategy that best suit them and that which they were able to afford in 2002, FAO, the West African Rice Development Association, National Agricultural Research systems in sub-Saharan Africa, and other partners supported the establishment of the African Rice Initiative to promote the development and use of NERICA (or New Rice for Africa) in upland rice production systems in the region. NERICA varieties generally have better tolerance to drought stresses [6]. IRRI also states. Establishment and development of efficient irrigation infrastructure, coupled with water-saving techniques, can help make the best use of limited water. Modified cropping patterns, improved nutrient supply and nutrient management strategies adjusted to available water resources, land leveling, and soil improvement may all help in times of drought.

In the case of flooding, proper seed and seedbed management practices, direct-seeding and optimal fertilizer use can help to have taller, healthier, less flood-susceptible plants that also recover better after flood exposure. Growing rice in the dry season, when floods are unlikely to occur, is also an option with potential in many regions.

Table 2. Respondents' Sources of Information

Source	Frequency	Percentage
Friends and family	78	86.7
Radio	77	85.6
Agric extension	60	66.7
Local leaders	48	55.3
Television	43	47.8

*Multiple Response**

Table 3. Level of Awareness of respondents on climate change

Statement	Very much aware	Aware	Just aware	Not aware	Mean	Standard deviation
Overflowing of streams and rivers	90 (100)	-	-	-	4.0	0.00
Extreme temperature	90 (100)	-	-	-	4.0	0.00
Loss of soil fertility	90 (100)	-	-	-	4.0	0.00
High sun intensity	90 (100)	-	-	-	4.0	0.00
Drying up of streams and rivers	90 (100)	-	-	-	4.0	0.00
Fluctuations in rainfall pattern	89 (98.9)	1(1.1)	-	-	3.98	0.10
Reduction in farm yield	77 (85.6)	6(6.7)	-	7(7.8)	3.92	0.26
Heavy winds	83 (92.2)	6(6.7)	1(1.1)	-	3.91	0.32
Unusual early rains that are followed by weeks of dryness	71 (78.9)	12 (13.3)	7 (7.8)	-	3.71	0.60
Erosion and flood	77 (85.6)	1 (1.1)	-	12(3.04)	3.58	1.02
Drought and longer period of dry season	47 (52.2)	1 (1.1)	42 (46.7)	_	3.05	0.99
Humidity and excessive dryness	47 (52.2)	_	43 (47.8)	_	3.04	1.00
Thunderstorm	34 (37.8)	6 (6.7)	38 (42.2)	12 (13.3)	2.68	1.11
No or reduced harmattan	16 (17.8)	7 (7.8)	38 (41.1)	30 (33.3)	2.65	0.87

Rating Scale: (very much aware=4; aware=3; just aware=2; not aware=1)

Table 4. Distribution of respondents by extent of perceived causes

Perceived causes	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	Mean	Standard deviation
Burning of crop household waste	72 (80.0)	18 (20.0)	-	-	-	4.80	0.40
The use of agrochemicals	77 (85.6)	-	13 (14.4)	-	-	4.73	0.68
Burning of fire wood for cooking	78 (86.7)	-	12 (13.3)	-	-	4.73	0.68
Burning of fossil fuel from machines	77 (85.6)	-	13 (14.4)	-	-	4.60	1.02
Gases released from cement production	78 (86.7)	-	-	12 (13.3)	-	4.60	1.02
Burning of fossil fuels by industries	78 (86.7)	-	-	12 (13.3)	-	4.60	1.02
Bush burning	49 (52.2)	43 (47.8)	-	-	-	4.52	0.50
Overgrazing of farmlands by livestock	38 (43.7)	42 (48.3)	-	-	-	4.36	0.62
Continuous cropping	34 (37.8)	37 (41.1)	7 (7.8)	-	12 (13.3)	3.90	1.29
Deforestation and indiscriminately cutting down of tress	12 (13.3)	43 (49.8)	34 (37.8)	-	1 (1.1)	3.72	0.73

Rating Scale: (strongly agree=5; agree=4; undecided=3; disagree=2; strongly disagree=1)

3.7 Extent of Adoption of Climate Change Strategies

As presented in Table 7, intensive manure application ($\bar{X}$ =3.96), increased weeding ($\bar{X}$=3.96), introduction to new variety of same crop ($\bar{X}$=3.81) and multiple cropping ($\bar{X}$=3.17) were all highly adopted by the respondents. Inter cropping ($\bar{X}$=2.44) and sowing earlier ($\bar{X}$=2.00) were adopted; expansion of cultivated land ($\bar{X}$=1.95), shifting planting date ($\bar{X}$=1.36) and switching cropping sequence ($\bar{X}$=1.36) were fairly adopted; mixed farming ($\bar{X}$ =0.67), contour cropping ($\bar{X}$=0.97), use of wetland ($\bar{X}$=0.67), changing from production to marketing ($\bar{X}$=0.66), improved irrigation ($\bar{X}$=0.64), shifting harvesting date ($\bar{X}$=0.64) were not adopted. However, these adaptation options are expected to produce benefits in short and long time dimension [19].

Table 5. Distribution of respondents by level of perceived effect of climate change

Perceived effect of climate change	very much affected	Much affected	Just affected	Not affected	Mean	Standard deviation
Increases in weeds	90 (100)	-	-	-	4.00	0.00
No or reduced harmattan	90 (100)	-	-	-	4.00	0.00
Insect and pest diseases	90 (100)	-	-	-	4.00	0.00
Reduction in farm yields	89 (98.9)	1 (1.1)	-	-	3.98	0.10
Increases in involvement of land encroachment	84 (93.3)	-	-	6 (6.7)	3.80	0.75
Fluctuation in rainfall	83 (92.2)	-	-	7 (7.8)	3.76	0.80
Loss of soil fertility	77 (85.6)	6 (6,7)	-	7 (7.8)	3.70	0.82
Long period of dry season	47 (52.2)	47 (52.2)	-	7 (7.8)	3.36	0.84
Over flowing of streams/rivers	53 (58.9)	-	30 (33.3)	7 (7.8)	3.10	1.11
Extreme temperature	49 (54.4)	7 (7.8)	-	34 (37.8)	2.78	1.42
Unusual early rains followed by weeks of dryness	19 (21.1)	30 (33.3)	-	34 (37.8)	2.37	1.19
Drought and longer period of dry season	12 (13.3)	37 (41.1)	-	34 (37.8)	2.30	1.11
High sun intensity	26 (28.9)	-	30 (33.3)	34 (37.8)	2.20	1.22
Delay in onset of rains	12 (13.3)	37 (41.1)	-	41 (45.6)	2.22	1.16
Erosion and flood	7 (7.8)	30 (33.3)	-	53 (58.9)	1.90	1.11
Heavy winds	-	-	12 (13.3)	78 (86.7)	1.13	0.34
Thunderstorm	-	-	12 (13.3)	78 (86.7)	1.13	0.34

Rating Scale (very much affected=4; much affected=3; just affected=2; not affected=1)
Source: Field Survey, 2014

Table 6. Distribution of respondents by adaptive strategies

Adaptive strategies	Frequency	Percentage
Intensive manure application	90	100.0
Use of wetlands/rivers	90	100.0
Contour cropping	90	100.0
Increased weeding	89	98.9
Expansion of cultivated land area	89	98.9
Introduction of new variety of same crop	88	97.8
Breeding of heat-and drought resistant crop	81	90.0
Move to a different site	82	91.1
Mixed farming(crop and animal production)	78	86.7
Multiple cropping	75	83.3
Change from production to marketing of products	74	82.2
Switching cropping sequence	58	64.4
Shifting planting date	53	58.9
Rely cropping	37	41.1
Shifting harvesting date	20	22.2
Improved irrigation efficiency	8	8.9
Planting deeper than usual planting depth	7	7.8
Sowing earlier	7	7.8
Mulching	0	0

Source: Field Survey, 2014

3.8 Hypotheses Testing

As indicated in the Table 8 below, the result of the hypotheses tested showed that the socio-economic characteristics which includes sex (χ^2 = 34.844), marital status (χ^2 = 110.467), primary occupation (χ^2 = 139.778), educational status (χ^2 = 60.844) has a significant relationship (χ^2 <0.05) with the respondents perception about climate change. This implies that any change in the socioeconomic characteristics will affect the respondents'

Table 7. Distribution of respondents by extent of adoption of adaptive strategies

Statement	Highly adopted	Adopted	Fairly adopted	Not adopted	Mean	Standard deviation
Intensive manure	89 (98.9)	-	-	1 (1.1)	3.96	0.31
Increased weeding	89 (98.9)	-	-	1 (1.1)	3.96	0.31
Introduction to new variety of same crop	85 (94.4)	-	-	5 (5.5)	3.81	0.79
Multiple cropping	46 (51.1)	30 (33.3)	-	52 (57.8)	2.24	1.10
Sowing earlier	30 (33.3)	1 (1.1)	-	59 (65.5)	2.00	1.44
Expansion of cultivated land	8 (8.9)	46 (51.1)	-	36 (40.0)	1.95	1.51
Shifting planting date	21 (23.3)	-	-	69 (76.6)	1.36	1.52
Switching cropping sequence	1 (1.1)	12 (13.3)	-	77 (85.5)	1.27	0.76
Contour cropping	10 (11.1)	-	-	80 (88.9)	0.97	1.17
Use of wetland	1(1.1)	-	-	89(98.9)	0.67	0.59
Mixed farming	1 (1.1)	-	-	89 (98.9)	0.67	0.59
Changing from production to marketing of agricultural products	-	-	-	89 (98.9)	0.66	0.54
Improved irrigation	-	-	-	90 (100)	0.64	0.48
shifting harvesting date	-	-	-	90 (100)	0.64	0.48

Rating Scale (highly adopted=4; adopted=3; fairly adopted=2; not adopted=1)
Source: Field Survey, 2014

perception of climate change because they are significantly related to perception of climate change. This finding agree with [20] who reported that when there is a direct proportionality between socioeconomic characteristics and perception, respondents will have a better perception about climate change.

Table 8. Chi-square analysis of the relationship between socio economic characteristics of the respondents' and perception of climate change

Variable	Chi-square	Df	P-value
Sex	34.844	1	0.000
Marital status	110.467	2	0.000
Primary occupation	139.778	3	0.000
Educational status	60.844	1	0.000

4. CONCLUSION

In Conclusion, the study concluded that rice farmers were very much aware of the fact that climate is changing and their level of perception varies. Intensive manure application, introduction of new variety of same crop and increased weeding were the mostly adopted coping strategies. Also that rice farmers' perception affects the adoption strategies and that farmers' perception is affected by their socio-economic characteristics. Information sources was mainly from radio and television to the farmers. It therefore recommends the planting of new varieties to farmers as a sure way to mitigate the effect of climate on rice production and that extension.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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