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Original Research Article

Perceived effectiveness of adaptation strategies to climate change among rice farmers in Jigawa State, Nigeria: Implication for rice production

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Abstract

This study assessed rice farmers' perceived effectiveness of adaptation strategies to climate change in Jigawa State, Nigeria. Multi-stage sampling procedure was used to select 183 respondents from whom data were collected using questionnaires. Data were summarised using descriptive statistics, Chi-square, and Pearson Correlation. Majority of the respondents were males (98%), married (90%) and had formal education (66.1%) with a mean age of 41 years. On the overall, more than half (56.3%) of the respondents perceived the effectiveness level of adaptation strategies to climate change to be low, whereas 43.7% perceived it to be high. Insufficient farm credit, high cost of raw materials, inadequate capital, high cost of labour, limited access to land and inadequate information on weather were the main constraints to adaptation to climate change. The inferential analysis revealed that years of farming experience (r = 0.172, p = 0.020), membership of cooperative (χ^2 = 4.207, p = 0.047) and level of education (χ^2 = 9.570, p = 0.023) and extension contact (χ^2 = 14.270, p = 0.000) were significantly associated with respondents' perceived effectiveness of adaptation strategies to climate change. Efforts should be made to sensitise farmers on the efficacy, appropriateness and applicability of adaptation strategies to foster favourable perception that will trigger positive attitude and subsequent adoption of the strategies where applicable. Government should implement policies that support farmers' access to credit facilities that is intended to help enhance farmers' capacity to build resilience. Farmers should be encouraged to take up membership of farm base associations so as to enjoy the benefits therein.

Keywords: Adaptation strategies; questionnaire study; climate change; perception; effectiveness; rice farmers

INTRODUCTION

The importance of rice to Nigeria cannot be overemphasized. It is a food item that is widely consumed across the country. The country is known to be the largest producer of rice in the continent but with huge dependence on importation to support demand requirements (Orifah et al., 2020). However, following the recent ban on importation by the Federal Government of Nigeria, the country's demand for rice can only be met from within (Orifah et al., 2020). Thus, the desire to become self-sufficient in this regard requires that farmers must first overcome production challenges which of course, include problems associated with climate change. Simulated outcomes have shown that, without mitigation strategies in place, climate change could cause changes in agricultural production that could result in food uncertainty for 9 billion people by 2050 (Ali et al., 2017).

Jigawa State represents one of the dominant rice-producing States in the Sahel with visible climate change challenges. According to Awere (2015), 635, 000 hectares of lowland rice were decimated by climate change events in Jigawa and Kebbi States in 2015. The State is affected by desert encroachment on the one hand, and this is worsened by erratic rainfall pattern and deforestation activities (Jigawa State Government, 2016; Orifah et al., 2018), and on the other hand, flooding is also a major occurrence in the State. For instance, in 2018, Tahir (2018) reported that 120, 000 hectares of farmland were destroyed by flood in 18 out of the 27 LGAs in the State. Similarly, in 2019, the Federal Radio Cooperation of Nigeria [FRCN] (2019), reported that flood destroyed about 12,000 hectares of farmland in the State with rice farmers suffering huge losses. There is also widespread invasion of weeds, particularly the Typha grass (*Typha latifolia*) that is restricting farming and fishing activities in most part of the State (Sabo et al., 2016). Putting these increasing challenges in perspective, it is imperative that farmers in the State must adopt strategies to curtail climate change events.

Climate change adaptation refers to spontaneous or organised processes through which human beings and societies adjust to changes in climate, thus, making changes in the operation of land and natural resource use systems and other forms of social and economic organisations (Quan and Dyer, 2008). The adoption of these strategies or technologies, is a function of perception among others. This line of thought is encapsulated in the position held by Adesina and Zinna (1993), and Mugandani and Mufongoya (2019) who averred that the decision to adopt a technology is associated with how the technology is perceived. Perception according to Ndamani and Watanabe (2015) has been characterised as the procedure by which living beings construe and bring together sensation to create a meaningful experience of the world. Most often, these established experiences are upheld and shared among peers who take up such perspective wholly to define their realities in terms of their attitude and behavioural dispositions towards the use of technologies. According to Oladele and Fawole (2007), farmers are active problem solvers as against the misgivings that they are passive recipients and users of technologies; they exhibit the capacity to weigh options, and decide on the appropriate course of action to take in addressing their challenges. Wrong or negative perception of technologies impact adversely on adoption and until adjustments are made to correct such impressions and the right perception formed in line with the appropriateness of such technologies, the decision to use such technologies becomes a mirage. This position is further amplified by Mugandani and Mufongoya (2019) who averred that positive perception favours adoption while negative perception creates the likelihood of technology rejection.

The importance of perception to farmers' uptake of technology/innovation cannot be overemphasised. Assessing farmers' perception and understanding, with respect to technology uptake, provide clues on enhancing farmers' willingness to accept innovations and direct technology developers on areas to modify or effect total change (Adesina and Zinna, 1993; Ndamani and Watanabe, 2015). Several adaptation strategies have been identified in literature (Deressa, 2009; Akinnagbe et al., 2012; Harmer and Rahman, 2014; Arimi, 2014; Nyengere et al., 2016; Enimu and Onome, 2018) that emphasised adaptation to the climate change events. However, these studies have established varied outcomes in terms of farmers' adoption of adaptation strategies. Similarly, most perception studies (Idrisa et al., 2012; Abdulhamid et al., 2015; Ndamani and Watanabe, 2015; Mesfin and Bekele, 2018; Mahmoodi-Momtaz et al., 2019) have focused on farmers' perception in relation to changes in the elements of climate without giving due consideration to how effective these strategies to combat or adapt to the changing climate are perceived by users. Juxtaposing the need to upscale rice production side by side the surge being experienced with climate change events in recent times in Jigawa State, Northwest Nigeria, it is therefore, imperative to understand how these strategies are perceived among rice farmers in Jigawa State.

The main objective of this study was to assess rice farmers' perception of the effectiveness of adaptation strategies to climate change in Jigawa State while the specific objectives were to:

i) identify the socio-economic characteristics of respondents;

ii) ascertain respondents' perceptions of the effectiveness of adaptation strategies to climate change;

iii) determine the relationship between respondents' socio-economic characteristics and perceived effectiveness of adaptation strategies to climate change and

iv) identify respondents' constraints to use of adaptation strategies to climate change.

The hypothesis for the study is stated as follows: there is no significant relationship between respondents' socio-economic characteristics and perceived effectiveness of adaptation strategies to climate change.

MATERIAL AND METHODS

The study was conducted in Jigawa State, Northwest, Nigeria between October 2018 and November 2019. Multi-stage sampling procedure was used to select rice farmers for this study. The first stage involved a purposive selection of one Local Government Area (LGA) from each of the four Agricultural zones in Jigawa (Birnin-kudu, Gumel, Hadeija and Kazaure zone), based on their prominence in rice production in the State.

The second stage was a purposive sampling of one dominant rice-producing village from each of the LGAs selected in the State, the villages were Miga, Suntuluma, Ayan and Madarawa in Miga, Ringim, Auyo and Kazaure LGAs, respectively. In the third stage, the list of rice producing farmers was obtained from Jigawa Agricultural and Rural Development Authority (JARDA) for the selected villages. Simple random sampling technique was thereafter employed to select a proportionate sample of 183 respondents for the study from a nested population of 346 rice farmers identified.

In determining this sample size (n = 183), the Raosoft online sample size calculator as used in Mason et al. (2018), and Orifah et al. (2020) was employed to determine the sample size for this study at 5% margin of error and 95% confidence interval. The Bowley's proportion allocation formula (Bowley, 1926) was thereafter used to establish the sample proportion from each of the villages selected for the study. Primary data were used for the study and these were collected using validated questionnaire. Data were collected on respondents' socio-economic characteristics, perceived effectiveness of climate change adaptation strategies, and constraint impeding adoption of climate change adaptation strategies. Perceived effectiveness was measured on the four-point Likert type scale of strongly agree, agree, disagree and strongly disagree with a score of 4, 3, 2 and 1, respectively. An index was generated and used to categorise perceived effectiveness into low and high levels of effectiveness. Constraints to adoption of adaptation strategies were measured on a four-point scale of high, moderate, low and not a constraint with a score of 3, 2, 1 and 0 accordingly. An index was computed (Problem Confrontation Index {PCI}) and the resulting values were used to rank the constraints according to the degree of severity.

Validation of instrument and reliability test

Content validity of research instrument was done with the help of Climate experts and research specialists. The process provided opportunity to correct the scale of measurements for vagueness and improve precision. The resulting instrument for data collection was pre-tested in Jigawa State of Nigeria. Internal consistency was measured and a Cronbach's Alpha coefficient of approximately 0.80 was obtained.

Method of data analysis

The obtained data were analysed using SPSS software (version 20). Descriptive statistics such as frequency, percentage, mean and standard deviation were used to analyse the data, while Chi-square, and Pearson Product Moment Correlation were used to test the hypothesis. The Problem Confrontation Index (PCI) for each constraint was computed following the approach of Uddin et al. (2014) and Ndamani and Watanabe (2015), this was thereafter used to rank the constraints in order of severity.

Model specification

This study employed Chi-square test, Pearson Product Moment Correlation test and Problem Confrontation Index approach.

Chi-square test is a nonparametric statistical analytical tool used to asses the probability of association or independence between variables that are categorical. The formula for the Chi-square test of independence according to Kostalova (2010) is specified as follows:

$$\chi^2 = \Sigma_{i=1}^{r}\Sigma_{j=1}^{c} \frac{\left(O_{ij} - E_{ij}\right)^2}{E_{IJ}} \quad (1)$$

where:

χ^2 = Chi-square value,

O_{ij} = Observed frequency of the ith row and jth column for the variables considered (sex, access to credit, membership of cooperative, access to information sources and extension contact and perceived level of effectiveness of climate change adaptation strategies {low or high}),

E_{ij} = Expected frequency of the ith row and jth column for the variables considered (sex, access to credit, membership of cooperative, access to information sources, extension contact and perceived level of effectiveness of climate change adaptation strategies {low or high}),

r = Number of rows in the contingency table,

c = Number of columns in the contingency table

$$E_{ij} = \frac{\sum_{k-1}^{c} o_{ij} \sum_{k-1}^{c} o_{kj}}{N} \quad (2)$$

where:

E_{ij} = expected value for the variables considered

$\sum_{k-1}^{c} o_{ij}$ = Sum of ith column for the variables considered

$\sum_{k-1}^{c} o_{kj}$ = Sum of k[th] row for the variables considered
N = Total number of observations
An important part of determining the critical value is computing the degrees of freedom

$$df = (r - 1) * (c - 1) \tag{3}$$

The decision rule is comparing the calculated Chi-square value (χ^2) with the critical value in the t-distribution table at the significance levels (α) and degrees of freedom. The statistical decision with respect to the null hypothesis depends on the validity of the inequality expressed in equation (4). If the calculated value is greater than the tabulated value at the specified level of significance and degrees of freedom, the null hypothesis is rejected; otherwise, it is accepted.

$$\chi^2 \geq \chi^2_{1-\alpha}\left[(r-1)*(c-1)\right] \tag{4}$$

The Pearson Product Moment Correlation (r) is a parametric analytical tool used to assess linear relationship between variables of interval measure. The Pearson's coefficient (r) value range between –1 and +1, where correlation value in the range of 0.8 and 1, 0.5 and 0.8, and less than 0.5 indicate a strong, medium, and weak correlation, respectively (Mohamad-Asri et al., 2016). The Pearson Product Moment Correlation is expressed as follows:

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{\left[n\left(\sum x^2\right) - \left(\sum x^2\right)\right]}\sqrt{\left[n\left(\sum y^2\right) - \left(\sum y^2\right)\right]}} \tag{5}$$

where:
r = Pearson's Product Moment Correlation Coefficient
N = Number of pairs of values or scores
x = Scores of each of the 'x' variables considered (age, household size, years of farming experience, yield of rice per hectare, farm size and annual income)
y = Scores for the 'y' variable (Perceived effectiveness of adaptation strategies' scores)
$\sum x$ = Sum of the x values (or x scores)
$\sum y$ = Sum of the y values (or y scores)
$\sum xy$ = Sum of the products of x and y
$\sum x^2$ = Sum of squares of x values (or x scores)
$\sum y^2$ = Sum of squares of y values (or y scores)
$\Sigma(x)^2$ = Square of the sum of x values (or x scores)
$\Sigma(y)^2$ = Square of the sum of y values (or y scores)

The decision rule is comparing the calculated t statistic with the critical value in the t-distribution table at the significance level (α) and degree of freedom. The statistical decision with respect to the null hypothesis depends on whether the calculated t statistic is less or greater than the tabulated value. If the calculated t value is less than the tabulated t, the null hypothesis is accepted. However, if it is otherwise, the null hypothesis is rejected and the alternate hypothesis is accepted.

$$t = \frac{r}{s_r} \tag{6}$$

where:
t = Calculated t statistic
r = Pearson's Product Moment Correlation Coefficient
s_r = standard error of estimate

$$s_r = \sqrt{\frac{1-r^2}{n-2}} \tag{7}$$

where:
s_r = standard error of estimate
r = correlation coefficient
n = number of samples

The Problem Confrontation Index (PCI) is an approach used to compute individual index for constraints based on perceived level of severity. It applies the principle of weighted frequency scores which was used for ranking the constraints. When following the approach of Uddin et al. (2014) and Ndamani and Watanabe (2015), the formula for estimating PCI is given as follows:

$$PCI = P_n \times 0 + P_l \times 1 + P_m \times 2 + P_h \times 3 \tag{8}$$

where:
PCI = Problem Confrontation Index
P_n = Frequency of the farmers who rated the problem as not encountered
P_l = Frequency of the farmers who rated the problem as low
P_m = Frequency of the farmers who rate the problem as moderate
P_h = Frequency of the farmers who rated the problem as high

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

The result in Table 1 shows that majority of the respondents were between the ages of 20 and 59 years. The mean age was 41 years. Age is often regarded as a measure of maturity, experience and capacity to perform certain task. The result in this study agrees with the finding of Kadiri et al. (2014) who reported a mean age of 49 years for rice farmers.

Table 1. Socio-economic characteristics of respondents (n = 183)

Variables	Frequency	%	Mean	SD
Age				
20–29	32	17.5	40.76	11.67
30–39	49	26.8		
40–49	52	28.4		
50–59	37	20.2		
60–69	10	5.5		
≥70	3	1.6		
Sex				
Male	181	98.9		
Female	2	1.1		
Marital status				
Single	15	8.2		
Married	166	90.7		
Divorce	1	.5		
Widowed	1	.5		
Separated	15	8.2		
Household size				
1–5	52	28.4	10.46	7.03
6–10	56	30.6		
11–15	33	18.0		
16–20	24	13.1		
21–25	13	7.1		
≥26	5	2.7		
Education level				
No formal education	62	33.9		
Primary education	37	20.2		
Secondary education	51	27.9		
Tertiary education	33	18.0		
Farm size (hectares)				
0.5–0.9	2	1.1	1.58	0.52
1.0–1.4	101	55.2		
1.5–1.9	12	6.6		
2.0–2.4	63	34.4		
2.5–2.9	4	2.2		
≥ 3.0	1	0.5		
Years of farming experience				
1–5	44	24.0	15.43	10.28
6–10	42	23.0		
11–15	20	10.9		
16–20	29	15.8		
21–25	16	8.7		
≥26	32	17.5		
Yield of rice per hectare (tons)				
1–1.99	24	13.1	2.69	0.67
2–2.99	108	59.0		
3.–3.99	42	23.0		
4–4.99	9	4.9		
5–5.99	24	13.1		
≥6	108	59.0		

Variables	Frequency	%	Mean	SD
Annual income (₦) from rice			268926.99	147334.67
100000–199000	87	47.5		
200000–299000	37	20.2		
300000–399000	24	13.1		
400000–499000	15	8.2		
500000–599000	7	3.8		
≥ 600000	13	7.1		
Membership of cooperative				
Yes	95	51.9		
No	88	48.1		
Access to credit				
Yes	103	56.3		
No	80	43.7		
Access to Extension contact				
Yes	116	63.4		
No	67	36.6		

Source: Field Survey, 2019
Note : ₦365 = 1 USD

The result suggests that majority of the rice farmers in the study area are relatively young and in their active ages and could perform production alongside adaptation activities. An overwhelming proportion (98.9%) of the respondents were males. The result obtained here may not be independent of the prevailing socio-cultural and religious environment which delineates job roles for both male and female. This assertion is in line with UNESCO (2000) who attributed such dominance to socio-cultural prejudice and stereotypes about what is considered male and female roles. The result corroborates the findings of Abdul-Gafar et al. (2017), who affirmed a male dominance in rice production. The result on marital status shows that majority (90.7%) of the respondents were married. The implication here is that married individuals dominate rice production. The result on marital status is in agreement with the findings of Ijogu (2016) who reported a similar trend. Furthermore, the mean household size shows 11 persons. This result on household size justifies the position of Ogundele and Okoruwa (2006) who alluded that the quest to satisfy labour requirements necessitates large household sizes among farmers in developing countries. The result of this study corroborates the findings of Mustapha et al. (2018), and Mohammed et al. (2015) who indicated a similar range for household sizes among rice farmers.

The result in Table 1 further shows that 33.9% of the respondents had non-formal education whereas the 66.1% had varying levels of formal education. Education forms the basis that drives understanding, create knowledge and build skills. The result suggests that rice farmers in the study area may exhibit some level of understanding of the demands of climate change and possible ways to avert its challenges. This assertion is in agreement with the position of Gasperini (2000) who opined that basic education affects subsistence farmers' productivity immediately and positively. The result on education is also in agreement with the findings of Ataboh et al. (2014), and Abdul-Gafar et al. (2017) who observed similar trend among rice farmers. Majority (96.2%) of the respondents had farm sizes of between 1–2.4 ha with a mean farm size holding of 1.58 ha. It can be inferred from the study that rice farmers in the area of study have small farm sizes. According to Mgbenka et al. (2015), farmers with farm holding that is less that 5 ha are small scale farmers. The result corroborates the findings of Mustapha et al. (2018) who observed an average of 1.6 ha for rice farmers. More so, the result in Table 1 shows that the average years of farm experience was 15.3 years. The result suggests that farmers have mustered some reasonable years of experience that could influence their production decisions and subjective positions with respect to adaptation strategies. This line of thought is in consonance with the findings of Sania et al. (2017); and Ousmanou and Alhadji (2017) who found that years of experience create a cutback on farmers' inefficiency. The result agrees with the findings of Kadiri et al. (2014) who observed the average years of experience for rice farmers to be 17 years. Table 1 further indicates that the average rice yield was 1.58 tonnes/ha. It can therefore be said that rice farmers in the study area had considerable yield per hectare. However, the yield

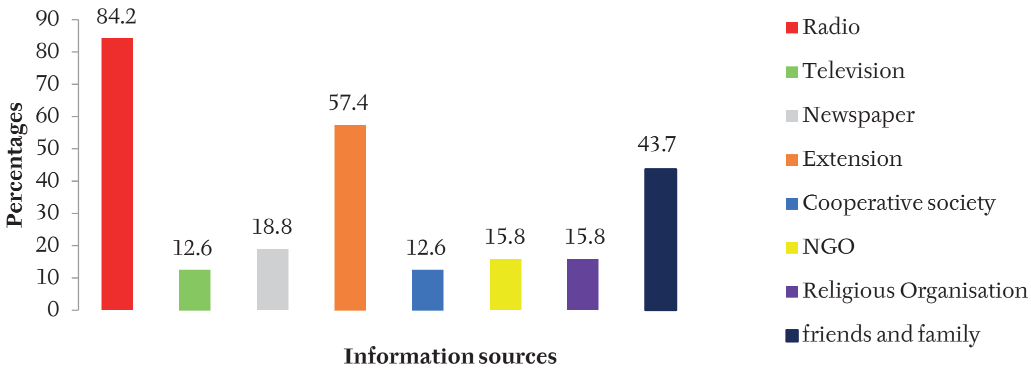

Figure 1. Distribution of respondents' sources of information

obtained was lower when compared with yield obtained from the preceding years. The result for yield contradicts the position of GIZ (2016) that reported an average of 5.6 tonnes/ha for Jigawa State. In the same region, Michigan State University (MSU) and IFPRI (2017) reported a similar increase from 1 tonne/ha in 2005 to an average of around 5.6 tonnes/ha in 2016 in Kebbi State. Similarly, Alarima et al. (2018) reported an average of 6.88 tonnes/ha in 2017 for Kebbi State as well. The result obtained, however, suggests that there are challenges with respect to rice production in the study area and unless positive measures are put in place to redirect production, rice yield will continue to dwindle. The mean annual income from rice production as shown in Table 1 was ₦268,926.99. The result negates the findings of Nasiru (2018) who reported a mean income of ₦627,698.78 (2,051.30 USD at the rate of ₦306 = 1 USD) for 2017 cropping season. The decline in the annual income might be a reflection of the drop in yield experienced. Curtailing yield and income losses require the adoption of the right adaptation mix, given the present environmental circumstance of the study area with respect to climate change events. This assertion is premised on the belief that technology or innovation adoption offers better opportunity when applied appropriately. According to Awotide et al. (2011), farmers with access to improved seeds for instance have the capacity to increase income by as much as about 23%. It can be argued from the result on the dwindling income on rice in the study area that farmers may lack the requisite financial standing to acquire certain important resources that are critical to climate change adaptation and this may influence how they perceived these strategies afterwards. This line of argument, aligns with the findings of Orifah et al. (2020) who identified low financial capacity to limit adoption of adaptation strategies. Again, Table 1, reveals that more than half (51.9%) of the respondents were members of cooperative association while a sizeable proportion (48.1%) do not belong to any cooperative group. The membership of farm base association offer farmers several opportunities and gains. Studies (Toluwase and Apata, 2013; Ahmed and Mefsin, 2017) have shown that membership of cooperative society has a significant positive relationship with productivity. The result from this study is in consonance with the findings of Abdulhamid et al. (2015) who reported that most (66%) rice farmers in Jigawa State were members of cooperative association and motivation for being, was to improve credit and information access. It can be implied that a larger proportion of rice farmers in the study area belong to a cooperative society and are positioned to take advantage of the benefits associated with group formation to curtail the impacts of climate related challenges. Similarly, more than half (56.3%) of the respondents had access to credit while 43.7% had no access to credit. Access to credit is strategic in fostering enterprise expansion for greater gains and when credit is lacking, particularly for farmers with low resource base, it becomes challenging to implement production and adaptation practices wholly. Thus, the output from such implementation may influence how those practices are perceived subsequently. The result contradicts the findings of Iliyasu et al. (2017) who reported that in spite of the presence of numerous credit sources in the state, majority (85%) of farmers lack access to credit facilities. Table 1 also reveals that 63.4% of the respondents had contact with extension agents while the remaining 36.6% had no extension contact. Extension contacts offers opportunity for capacity building and livelihood improvement. This declaration is in line with the position of Agumagu and

Table 2. Distribution of respondents based on perceived effectiveness of adaptation strategies to climate change (n = 183)

S/N	Perception Statements	SA	A	D	S D	Mean
i	Use of chemical herbicides help reduces the cost of human labour	102(55.7)	79(43.2)	2(1.1)	-	3.55
ii	Cover crops has the tendency to retain moisture and prevent erosion	82(44.8)	97(53.0)	3(1.6)	1(0.5)	3.42
iii	Soil fertility is significantly improved by crop rotation	72(39.3)	104(56.8)	5(2.7)	2(1.1)	3.34
iv	Irrigation successfully replaces rainfall during periods of dry spell and drought	70(38.3)	108(59.0)	3(1.6)	2(1.1)	3.34
v	Moisture loss is potentially reduced through mulching	72(39.3)	99(54.1)	9(4.9)	391.6)	3.31
vi	Afforestation can reduce soil degradation through improving soil organic matter	66(36.1)	108(59.0)	9(4.9)	-	3.31
vii	Organic fertilisers are more environmentally friendly than synthetic fertilisers	71(38.8)	100(54.6)	8(4.4)	4(2.2)	3.30
viii	Mixed farming ensures some form of certainty in the face of climate change	63(34.3)	109(59.6)	10(5.5)	1(0.5)	3.28
ix	Changing crop variety has helped to curtail the loss in yield experienced with local variety as a result changes in climate	67(36.6)	105(57.4)	7(3.8)	4(2.2)	3.28
x	Harvesting water can greatly support agricultural activities during dry spell	60(32.8)	113(61.7)	9(4.9)	1(0.5)	3.27
xi	Degraded forest can be rejuvenated through afforestation	60(32.8)	110(60.1)	13(7.1)	-	3.26
xii	River bank cultivation have been effective during dry spell	58(31.7)	116(63.4)	6(3.3)	3(1.6)	3.25
xiii	Planting across slope has the potentials to reduce run off	55(30.1)	120(65.5)	6(3.3)	2(1.1)	3.24
xiv	Chemical fertiliser has potential of improving soil fertility	62(33.9)	103(56.3)	15(8.2)	3(1.6)	3.22
xv	Changing planting and harvesting date has shown greater potential for dealing with issues of pest and disease	58(31.7)	109(59.6)	14(7.7)	2(1.1)	3.22
xvi	Pest and disease resistant variety have shown greater resilience to pest and disease in infected areas	69(37.7)	105(57.4)	8(4.4)	1(0.5)	3.22
xvii	Minimum tillage has the potential to reduce soil exposure to erosion	46(25.2)	131(71.6)	6(3.3)	-	3.21
xviii	Crop diversification has created some form of complimentary effect to reduce the intensity of climate change on main crop production	39(21.3)	136(74.3)	7(3.8)	1(0.5)	3.16
xix	Increased frequency of weeding effectively solves increased incidence of weeds	53(29.0)	111(60.7)	12(6.6)	7(3.8)	3.15
xx	Changing of planting and harvesting date has shown greater potential for dealing with the issues of variation in rainfall regime	49(26.8)	115(62.8)	16(8.7)	3(1.6)	3.15
xxi	Increased frequency of weeding with human labour is burdensome	52(28.4)	114(62.3)	9(4.9)	8(4.4)	3.15
xxii	Chemical fertiliser has the potential to contribute to climate change	45(24.5)	123(67.2)	10(5.5)	5(2.7)	3.14
xxiii	Use of inorganic chemical herbicides is not environmental friendly	47(25.7)	108(59.0)	18(9.8)	10(5.5)	3.05
xxiv	Increased use of family labour reduces the challenge created by climate change	38(20.8)	121(66.1)	16(8.7)	8(4.4)	3.03
xxv	Fungi inoculation of degraded forest have been useful in rejuvenating degraded forest	28(15.3)	126(68.9)	26(14.2)	3(1.6)	2.98
xxvi	Agricultural insurance has always been supportive during crop failure from climate related issues	33(18.0)	123(67.2)	17(9.3)	10(5.5)	2.98
xxvii	Biofuel is cleaner energy source and environmentally friendly when compared to other source	34(18.6)	101(55..2)	45(24.6)	3(1.6)	2.91

*Figures in parentheses are percentages. S/N = Serial Number, SA = Strongly Agree, A = Agree, Disagree = SD = Strongly Disagree
Source: Field Survey, 2019

Nwaogwugwu (2006) and Ajayi and Solomon (2010) who averred that extension agent perform technology disseminator roles to improve farmer's capacity to function. The result obtained is in tandem with the findings of Abdullahi et al. (2018) who observed that a vast proportion (97%) of farmers in the region had contacts with extension agents. It can be implied that rice farmers in the study area had extension contact. The result suggests that rice farmers might have had some levels of enlightenment and technology introduction as it concerns climate change and may ultimately influence their perception with respect to the efficacy of adaptation strategies. The result in Figure 1 revealed that the major sources of information were radio (84.2%), extension agents (57.4%) and family and friends (43.7%). Sources of information are considered as means of propagating ideas. The greater the number of information sources available to the respondents, the greater the likelihood that climate change information will be accessed; particularly, for regions where the challenge is endemic and authorities are proactive to address situations. The result agrees with the findings of Chukwuji et al. (2019) who identified radio, extension agents as major sources of information on climate in Zamfara State. It can therefore be implied that rice farmers in the study area had access to information sources.

Perceived effectiveness of adaptation strategies to climate change

Results in Table 2 indicates that respondents' perceived effectiveness of adaptation strategies to climate change was highest for the statement item "use of chemical herbicides help reduce the cost of human labour" ($\bar{x}$ = 3.55). This was followed by "cover crop has the tendency to retain moisture and prevent erosion"($\bar{x}$ = 3.42), "soil fertility is significantly improved by crop rotation" ($\bar{x}$ = 3.34) and "irrigation successfully replaces rainfall during periods of dry spell and drought" ($\bar{x}$ = 3.34) in that order. However, the least perception means were observed for the statement item "fungi inoculation of degraded forest have been useful in rejuvenating degraded forest" ($\bar{x}$ = 2.98), "agricultural insurance has always been supportive during crop failure from climate related issues" ($\bar{x}$ = 2.98) and "biofuel is cleaner energy source and environmentally friendly when compared to other source" ($\bar{x}$ = 2.91). It can be implied that use of chemical herbicides, cover cropping, crop rotation and use of irrigation were adaptation strategies perceived to be most effective in the study area.

Furthermore, the overall results in Table 3 reveals that more than half (56.3%) of the respondents perceived the effectiveness level of these strategies to be low, whereas 43.7% perceived it to be high. It can be inferred that rice farmers have negative perception in terms of the effectiveness of these strategies. The result also suggests that there is information gap in farmers' understanding and application of these strategies. The result on the overall perception of these strategies could be responsible for the losses being recorded over the years since perception influence attitude toward innovations. It therefore establishes the need to create some level of sensitization to redirect farmers' perception of the strategies as it exerts positive influence on its applicability. This line of thought is in consonance with Meijer et al. (2015) who averred that perception and knowledge about a technology influences attitude towards the technology and its adoption.

Constraints to use of adaptation strategies to climate change

The results in Table 4 reveal that insufficient farm credit (PCI = 499) was ranked the highest constraint faced by respondents to use of adaptation strategies to climate change. This was followed by high cost of raw materials (PCI = 494), inadequate capital (PCI = 494), high cost of labour (PCI = 493), limited access to land (PCI = 486) and inadequate information on weather (PCI = 485). On the other hand, the least ranked constraints to use of adaptation strategies experienced by respondents were insufficient irrigation facilities (PCI = 436), limited access to water (PCI = 406) and insufficient market access (PCI = 397). The findings on insufficient credit suggest that farmers do not have the financial standing to execute adaptation operations. More so, inadequate information on weather is indicative of the fact that the agencies saddled with the responsibilities to provide information on weather might not have fully explored the information sources available to the farmers. Furthermore, the result suggests that there is no established framework to curtail the effects climate change in the study area.

Table 3. Distribution of respondents' based on level of perceived effectiveness of adaptation strategies to climate change (n = 183)

Level of effectiveness	Frequency	%	Min. score	Max. score	Mean
Low	103	56.3	66	108	87
High	80	43.7			

Source: Field Survey, 2019

Table 4. Distribution of respondents based on constraints to use of adaptation strategies to climate change (n = 183)

S/N	Constraints	H	M	L	NC	PCI	Rank
1	**Insufficient farm credit**	156(85.2)	15(8.2)	1(0.5)	11(6.0)	499	1st
2	**High cost of raw materials**	150(82.0)	21(11.5)	2(1.1)	10(5.5)	494	2nd
3	**Inadequate capital**	157(85.8)	9(4.9)	5(2.7)	12(6.6)	494	2nd
4	**High cost of labour**	148(80.9)	23(12.6)	3(1.6)	9(4.9)	493	4th
5	**Limited access to land**	144(78.7)	27(14.4)	-	12(6.6)	486	5th
6	**Inadequate information on weather**	148(80.9)	19(10.4)	3(1.6)	13(7.1)	485	6th
7	**Limited access to raw materials**	140(76.4)	25(13.7)	7(3.8)	11(6.0)	477	7th
8	**Inadequate access to improved technology**	145(79.2)	18(9.8)	3(1.6)	17(9.3)	474	8th
9	**High cost of adaptation**	143(78.1)	21(11.5)	2(1.1)	17(9.3)	473	9th
10	**Poor technical know-how in implementing adaptation strategies**	146(79.8)	16(8.7)	3(1.6)	18(9.8)	473	9th
11	**Complexity of the adaptation strategies**	150(82.0)	6(3.3)	7(3.8)	20(10.9)	469	11th
12	**Land tenure system**	137(74.9)	26(14.2)	3(1.6)	17(9.3)	466	12th
13	**Limited mobility of resources**	134(73.2)	27(14.8)	5(2.7)	17(9.3)	461	13th
14	**High labour involvement**	135(73.8)	25(13.7)	6(3.3)	17(9.3)	461	13th
15	**Poor access to extension service delivery**	116(63.4)	28(15.3)	2(1.1)	37(20.2)	406	17th
16	**Rationing of resources**	132(72.1)	21(11.5)	8(4.4)	22(12.0)	446	15th
17	**Insufficient irrigation facilities**	127(46.4)	26(14.2)	3(1.6)	27(14.8)	436	16th
18	**Limited access to water**	106(57.9)	41(22.4)	6(3.3)	30(16.4)	406	17th
19	**Insufficient market access**	119(65.0)	19(10.4)	2(1.1)	43(23.5)	397	19th

Figures in parentheses are percentages; S/N = Serial Number, H = High, M = Moderate, L = Low, NC = Not a constraint; PCI = Problem Confrontation Index
Source: Field Survey, 2019

The results from this study corroborate the findings of Kolleh and Jones (2018) who identified lack of information about climate change, and lack of access to credit, among the major constraints limiting farmers' adaptation to climate in Ketu North District, Volta Region of Ghana. Similarly, Adesiji and Obaniyi (2012) identified, inadequate information on weather, limited access to land, and limited access to credit, among the major constraints to adaptation to climate change. In the same vein, the result is in line with the finding of Idrisa et al. (2012) who observed that the major constraints limiting adoption of adaptation strategies to climate change in Northeast Nigeria were poor financial resource base of the farmers, inadequate weather information, poor access to technology necessary for adaptation and poor access to extension services.

Test of relationship between socio-economic characteristics of respondents and level of perception of the effectiveness of adaptation strategies to climate change

The Pearson correlation and Chi-square analysis test results are presented in Table 5. The Pearson correlation result shows that age, yield, farm size, and income were not significantly related to respondents' perceived effectiveness of adaptation strategies to climate change. However, years of experience ($r = 0.172$, $p = 0.020$) was significantly correlated with perceived effectiveness of adaptation strategies to climate change at 5% level of significance. The correlation result on years of experience though significant indicates a weak positive relationship with farmers' perceived effectiveness of adaptation strategies. However, it can be inferred that both variables are correlated. What this simply means is that as years of experience increases, it is expected that a favourable perception is formed in terms of the effectiveness of adaptation strategies. Years of farming experience offers farmers the opportunity to learn from their experiences and equally make better production decisions. Furthermore, the Chi-square result reveals that access to credit and information sources were not significantly associated with the level of perceived effectiveness of adaptation strategies to climate change. Conversely, membership of cooperative ($\chi^2 = 4.207$, $p = 0.047$) and level of education ($\chi^2 = 9.570$, $p = 0.023$) were significantly associated with respondents' level of perceived effectiveness of adaptation strategies to climate change at 5% level of significance while extension contact ($\chi^2 = 14.270$, $p = 0.000$) was significantly associated with level of perceived effectiveness of adaptation strategies to climate change at 1% level of significance. The import here, is that the proportion of respondents

Table 5. Chi square ($\chi 2$) and Pearson Product Moment Correlation (r) test of relationship between respondents' socioeconomic characteristics and perception of the effectiveness of adaptation strategies to climate change (n = 183)

Variables	χ^2-value	Df	*r*-value	*p*-value
Age			0.074	0.318
Sex	0.143	1		1.00
Household size			0.143	0.054
Years of experience			0.172**	0.020
Yield of rice per hectare			0.010	0.897
Farm size			0.074	0.321
Access to credit	0.284	1		0.645
Membership of cooperative	4.207**	1		0.047
Annual income			0.057	0.445
Access to information sources	1.669	1		0.238
Extension contact	14.270***	1		0.000
Level of education	9.570**	3		0.023

** Significant at 5%; and *** Significant at 1%
Source: Field Survey, 2019

in the categories with respect to membership of cooperative society, level of education and extension contact differ in their perception of the level of efficacy of adaptation strategies to climate change. It can therefore be inferred from this study that years of experience, membership of cooperatives, extension contact and level of education are key variables that are related with rice farmers' perceived effectiveness of adaptation strategies to climate change. The result on farmers' years of experience is in agreement with the findings of Adeola and Adetunbi (2015) who found years of experience to be related with farmers perception of sustainable agricultural practices. Similarly, the result corroborates the findings of Bagheri et al. (2008) who reported significant relationship between educational levels, years of farming experience, extension contact and farmers' perception of sustainable agricultural technologies.

CONCLUSION

The study concludes that use of chemical herbicides, cover cropping, crop rotation and use of irrigation were perceived to be the most effective adaptation strategies in the study area. However, on the overall, a higher proportion of farmers perceived adaptation strategies to climate change to be less effective. Insufficient farm credit, high cost of raw materials, inadequate capital, high cost of labour, limited access to land, and inadequate information on weather were the major constraints to adoption of adaptation strategies. The inferential statistics revealed significant association between years of experience, level of education, membership of cooperative, extension contact and farmers' perceived effectiveness of adaptation strategies to climate change. To increase and sustain rice production, it is recommended that efforts should be made to sensitize farmers on the efficacy and appropriateness of adaptation strategies to foster favourable perception that will trigger positive attitude and subsequent adoption of the strategies where applicable. The extension delivery system should be proactive in this regard and align its mandate to accommodate provision of information on climate change and adaptation strategies to farmers to help them form positive perception given that these strategies have been proven to be effective if applied appropriately. Efforts should also be made to develop efficient weather information system that provides early warning information on climate to guide farmers appropriately. Government should implement policies that support farmers' access to credit facilities that is intended to help enhance farmers' capacity to build resilience. Farmers should be further encouraged to belong to association to take advantage of the benefits therein.

CONFLICT OF INTEREST

The authors declared no conflicts of interest with respect to research, authorship and publication of this article.

ETHICAL COMPLIANCE

The authors have followed the ethical standards in conducting the research and preparing the manuscript.

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