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Indigenous Practices for Climate Change Adaptation among Rural Households in Imo State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors PCU and NO designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript and managed literature searches. Authors PCU, NO and AOA managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Climate change has been described as among the major challenges of the twenty-first century. However, this trend cannot be completely halted but can only be slowed down through the development and adoption of adaptation practices especially among the rural people whose major source of livelihood is agriculture which is at stake. This paper examined the indigenous practices for climate change adaptation among rural households in Imo State. A multistage sampling procedure was used to select the sample. A total of 108 respondents were used for the study. Descriptive statistics were used in analyzing the data obtained from the study. Results show that a majority (78.3%) of the respondents were aware of climate change while about 40.6% knew a very little about it. The result also shows that the most effective local adaptation practices to climate change in the study area included growing drought-resistant crop varieties (M = 1.14), planting deeper into the soil to avoid heat stress (M = 1.10), increased weeding (M = 1.29) and changing the timing of land preparation (M = 1.10). Further, the results show that major constraints to

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adaptation to climate change in the study area included limited access to improved crop varieties (M = 1.95), high cost of farm labour (M = 1.80), inadequate financial resources to adapt (M = 1.80) and high cost of diversification of enterprise (M = 1.78). The paper recommends the massive involvement of the extension agency and the mass media in climate change adaptation programmes so as to raise the awareness of people on the subject and thus increase their adaptive capacity.

Keywords: Indigenous practices; climate change; adaptation; rural households.

1. INTRODUCTION

The global scientific community views climate change as the most significant environmental threat of the 21st century – endangering the sustainability of the world's environment, its agriculture and consequently the well-being of its people. The warming of the earth is now evident from the rising air and ocean temperature, widespread melting of ice and snow and the rising global mean sea level [1].

Climate change refers to changes in the climate that are attributed directly or indirectly to human activity that alter the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable periods [2]. It also refers to any change in climate over time due to natural variability or as a result of human activity [3].

Climate change occurs when something alters the amount of heat energy from the earth's surface and atmosphere that escapes to space over an extended period of time. Natural factors such as volcanic eruptions, El-Nino Southern Oscillations, changes in ocean currents and fluctuations in solar output can cause climate change. However, following the industrial revolution of the 21st century, human-induced (anthropogenic) factors such as burning of fossil fuels, changes in land use and deforestation have become significant causes of climate change [4]. These human activities release greenhouse gases mainly CO_2, N_2O and CH_4 into the atmosphere thereby increasing their concentration which results in climate change [5].

According to Lokupitiya and Paustian [6] agriculture accounts for between 10% and 20% of total anthropogenic GHGs released into the atmosphere through such processes as manure decomposition, livestock production, wetland rice production and conversion of forests and grasslands to cultivated systems thus making it a major emitter of GHGs. In 2005, agriculture accounted for 10 – 12% of the total global anthropogenic emissions of GHGs, with 47% of the total anthropogenic CH_4 emissions and 58% of anthropogenic N_2O emissions coming from the sector [4]. According to Helmuth et al. [7] about 80% of the total emissions from agriculture come from developing countries. As long as the need to meet up with the rising food demand in these countries is pursued, emissions from agriculture is likely to continue rising. However, this is dependent on the agricultural management systems used, as some systems have the potentials of restricting the soil's ability to sequester carbon [8].

Agriculture however, is among the human activities that will be most affected by climate change despite its significant contributions to it due mainly to its dependence on environmental conditions (SACAU, 2009). This is expected to be more pronounced in sub-Saharan Africa where more than 70% of the working population engages in agriculture [9]. This translates into significant impacts on large numbers of people and their livelihoods [5]. According to International Fund for Agricultural Development, IFAD [10] about 95% of agriculture in Africa directly depends on rainfall which makes African agriculture particularly vulnerable to climate change induced rainfall alterations. For example, annual rainfall in most parts of Nigeria has decreased during the 1961-1990 period relative to the 1951-1960 period. More areas of the country are experiencing late onset of rains with only a narrow band in the middle belt and some locations in the Southwest where normal conditions still prevail [11]. Also, Desanker and Magadza [12] project a future warming across Africa ranging from 0.2ºC per decade (low scenario) to more than 0.5ºC per decade (high scenario). Bates et al. [13] maintain that increased evaporation and evapo-transpiration with associated soil moisture deficits will impact rainfed agriculture. Sea level rise as a result of rising temperatures will cause sub-mergence of low lands and intrusion of salt water thus leading to the loss of coastal agricultural lands [14]. Likely outcomes as a result of these trends include poor soil quality, low crop and animal yields, increased pests and diseases attack and increased drought and desertification [15] and increased soil erosion [8]. Recent estimates show that for each 1ºC rise in average temperature dryland farm profit will drop by nearly 10% [16]. These effects on agriculture could lead to food insecurity in most developing countries thus making the people more vulnerable [17].

The challenges posed to agriculture as a result of climate change can however be reversed or reduced through the application of appropriate management practices [5]. Local people in Africa have managed the changing climate over the years through the development and use of indigenous adaptation practices. According to Kelbessa [18] such practices include diversified resource base (to minimize the risk due to harvest failure, they grow many different crop varieties, and they also hunt, fish and gather wild food plants); change in crop varieties and species of animals, change in the timing of activities (crop harvest, wild plant gathering, hunting and fishing); change of techniques; change of location, change in resources and/or life style (resorting to wild foods in the case of emergency situations such as drought and floods); exchange (obtaining food and other necessities from external sources through exchange, reciprocity, barter or markets in times of crises), and resource management (enhancing scarce and climate-sensitive resources management). However, such practices have not been properly identified and documented [19]. Therefore, it is pertinent to ask the following questions: what is the awareness level of rural households to climate change? What local adaptation practices have they adopted to respond to climate change? And what are the constraints to adaptation to climate change in the study area?

2. PURPOSE AND OBJECTIVES OF THE STUDY

The overall purpose of the study was to ascertain the indigenous practices for climate change adaptation among rural households in Imo State, Nigeria. Specifically, the objectives were to:

1. Ascertain the awareness level of awareness of respondents to climate change;
2. Determine the local adaptation practices adopted by respondents; and
3. Identify the constraints to adaptation to climate change in the study area.

3. METHODOLOGY

The study was carried out in Imo State which is among the five states in the Southeast geopolitical zone of Nigeria. It lies within latitude 4º 45'N and 7º 15' N and longitude 6º 50'E and 7º 25'E and covers an area of about 5100 square kilometres (www.imostate.gov.ng [20]). It is divided into three political zones – Owerri, Okigwe and Orlu and comprises 27 local government areas as shown in Map 1. The population of the state stands at 4.8 million people and the population density varies from 230 persons per square kilometer in Oguta / Egbema areas to about 1,400 persons per square kilometer in Mbaise, Mbano, and Mbaitoli areas [21].

The high population density has led to an increased pressure on the land, forests and other natural resources resulting in increased rural poverty which is characteristic of densely populated rural areas (www.imostate.gov.ng [20]). Rainfall distribution is bi-modal with peaks in August and September. The rainy season begins in March and lasts till October. Variation in annual rainfall is between 1990 mm-2200 mm. Temperature is uniform in the State with mean annual temperature of about 20ºC. The annual relative humidity is 75% (www.imostate.gov.ng [20]). The State lies within the rainforest agro-ecological zone of Nigeria.

The major economic activity of the people is farming which confirms the predominance of rural communities in the state. Major crops grown include cassava (*Manihot esculenta*), maize *(Zea mays*), yam *(Dioscorea esculenta*), cocoyam (*Colocasia esculenta*) and rice *(Oryza sativa*) etc. Economic trees commonly found are Iroko (*Chlorophora excelsa*), mahogany (*Sweitenia mahagoni*), Obeche, rubber (*Hevea brasiliensis*) and oil palm (*Elaeis guineensis*) etc. The State is rich in mineral resources like crude oil, natural gas, lead, zinc, aluminium, etc which have attracted many industries such as the aluminium extraction industry in Inyisi, Ikeduru; and oil drilling companies at Izombe in Oguta. There are several water bodies in the State and the prominent ones include Oguta lake, Abadaba lake, Imo river and Urashi river, etc. The State is also a site for natural disasters like erosion (www.imostate.gov.ng [20]).

The population for the study comprised all rural households in the state. Multi-stage sampling procedure was used for the selection of the sample. The first stage comprised the purposive selection of one LGA from each of the three political zones in the state based on the peculiar vulnerability of the areas to climate change and risks including erosion, flooding, oil explorations, and other natural disasters. The second stage involved the selection of one autonomous community from each of the three LGAs using purposive sampling technique to include the vulnerable communities. The most vulnerable communities were determined through a preliminary survey.

The third stage involved the purposive selection of three villages from each of the three autonomous communities based on the criteria stated above. Finally, twelve household heads were purposively selected from each of the three villages. Their selection was based on their years of experience in farming in order to be able to elicit from them useful information relating to climate change and local adaptation strategies. However, this was determined through a preliminary survey. In all, a total of three LGAs, three autonomous communities, nine villages and 108 household heads were used for the study. Therefore, the sample size for the study was 108 as shown in Table 1.

Data for this study were obtained from primary sources. This was achieved through the use of a structured questionnaire and interview schedule. Content and face validity of the instruments was done by lecturers in the Department of Agricultural Extension, University of Nigeria Nsukka. Section A ascertained the awareness level of the respondents to climate change (Objective 1). In order to achieve this, respondents were asked to indicate their level of awareness on climate change and their responses were measured using a nominal scale of know a lot = 3, know = 2, know a little = 1 and do not know = 0. Then percentage distribution was used to determine the proportion of the respondents that fell into each category. Their source(s) of awareness was measured as radio = 1, fellow farmers = 2, extension agents = 3, agribusiness operators = 4, newspapers = 5 and others = 6. Section B ascertained the local adaptation practices used by respondents (Objective 2). To achieve this, a list of possible local adaptation practices obtained from literature and field observations were made available and the respondents were requested to indicate the ones they used and this was measured on a 3-point Likert-type scale of Very Effective (VE) = 2, Effective (E) = 1 and Not Effective = 0. The mean score of the strategies were obtained as 1.00 and any item with M $\geq$ 1.0 was taken as an effective adaptation strategy in the study area while those with M < 1.0 were not. Section C ascertained the constraints to adaptation to climate change in the study area (Objective 3). To achieve this, a list of possible constraints to effective adaptation to climate change obtained from relevant literatures and field observations were provided and the respondents were requested to indicate their perceptions on each of them measured on a 4-point Likert- type scale of Strongly Agreed (SA) = 3, Agreed (A) = 2, Disagree (D) = 1 and Strongly Disagree (SA) = 0. The mean score was obtained as 1.5 and items with M $\geq$ 1.5 were regarded as perceived constraints to effective adaptation. Objective 1 was analyzed using percentages while objectives 2 and 3 were analyzed using mean statistic, standard deviation, charts and factor analysis where only loadings of $\geq$ 0.4 were accepted [22].

4. RESULTS AND DISCUSSION

4.1 Awareness Level of Respondents on Climate Change

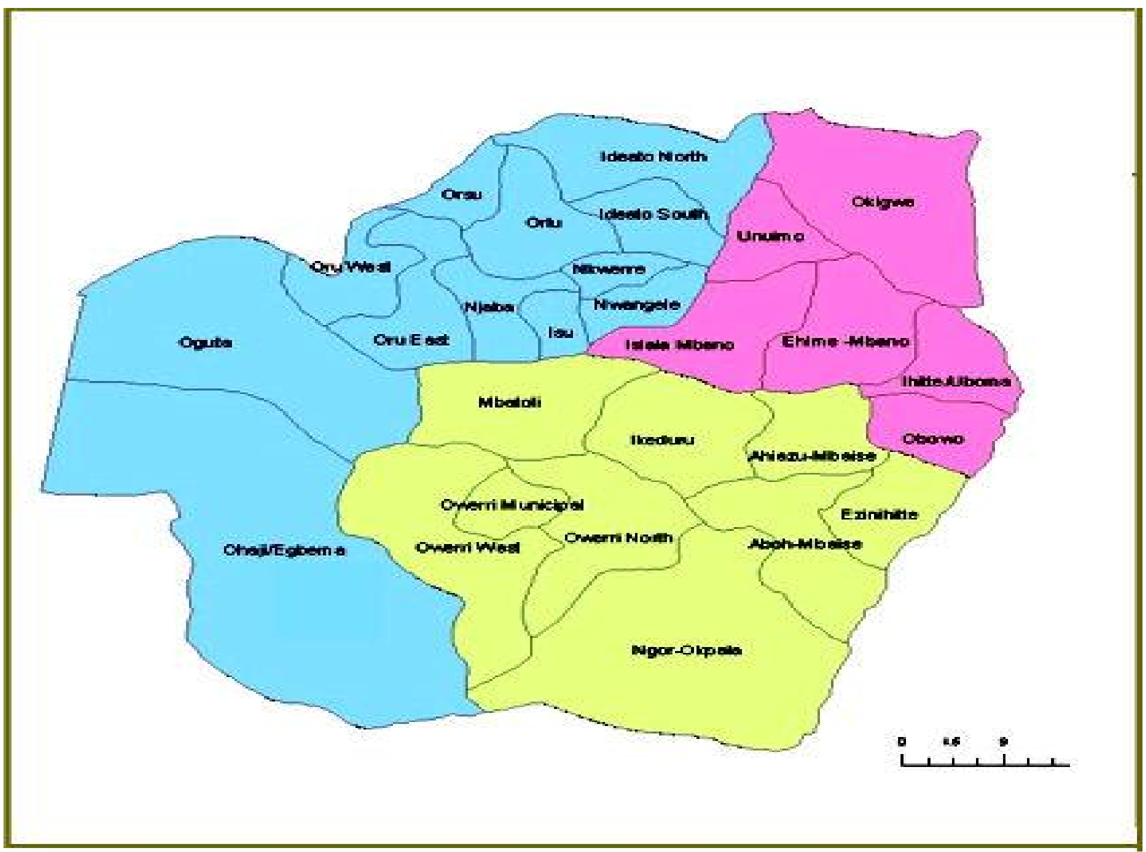
Data in Table 2 show that the majority (78.3%) of the respondents were aware of climate change whereas the remaining 21.7% were not. This shows that most farmers in the study area already have noticed that the climate is changing or have heard that it is changing. It confirms the assertion of the Southern African Catholic Bishops' Conference (SACBC) [23] that most Africans are aware that weather and climate patterns are changing. The awareness of climate change has also been documented in a finding by Ozor et al. [24] who observed that most farmers in Southern Nigeria are aware of climate change issues. Awareness of climate change will enable farmers to prepare themselves to adapt to the situation by evolving numerous farming system strategies within their locality.

On the level of awareness of climate change, the data indicate that greater proportion (40.6%) of the respondents know a little about climate change issues while 31.1% and 6.6% know and know a lot about climate change respectively. This shows that many farmers in the rural area have observed or have heard there are noticeable changes in climate pattern but they do not know much about it. This supports the report of Aklilu [25] that information about climate change in Africa is still confined within the academia and research institutes and as a result many local farmers though aware of it, lack sufficient knowledge about it.

The finding is also consistent with the findings of the 2007 Annual South African Social Attitudes Survey by the Human Resources Research Council [26] that about 6.0% of the respondents interviewed in South Africa indicated that they knew a lot about climate change while the majority indicated that they knew a little. This implies that many farmers have limited knowledge about climate change.

Table 1. Population and sampling procedure for the study

Zones	LGAs	Autonomous communities	Villages	Sample size of HH
Owerri	Mbaitoli	Ogbaku	Okwu	12
			Obibi	12
			Lawa	12
Orlu	Oguta	Ejemekwuru	Umuagwu	12
			Umuolowu	12
			Umuakum	12
Okigwe	Isiala Mbano	Ibeme	Umunnenku	12
			Umuezeala	12
			Umuokparaoma	12
Total	**3**	**3**	**9**	**108**



Map. 1. Map of Imo state, Nigeria

Table 2. Distribution of respondents according to awareness of climate change (n= 108)

Climate change awareness	%
Yes	78.3
No	21.7
Level of awareness	
Know a lot	6.6
Know	31.1
Know a little	40.6

Source: Field survey, September 2010

4.2 Local Adaptation Practices for Climate Change

Data in Table 3 show that the effective local adaptation practices perceived by farmers as effective to address climate change in the study area included; growing drought-resistant crop varieties (M = 1.14), use of pest/disease resistant crop varieties (M = 1.06), roof water harvesting (M = 1.00), sinking more wells (M = 1.06), ground water harvesting (M = 1.07), planting deeper into the soil to avoid heat stress (M = 1.10), increased weeding (M = 1.29), changing planting dates (M = 1.05) and changing timing of land preparation (M = 1.01). This is in line with the documentation by Kurukulasuriya and Mendelsohn [27] that African farmers are adapting to climate change through such strategies which include increased use of water and soil conservation techniques, changing planting / sowing dates, using crop varieties and livestock species that are more suited to drier conditions, tree planting (afforestation) and crop diversification.

The use of drought-resistant crop varieties has been found to be an effective adaptation strategy to climate change. In the face of the intensifying drought and increased desertification owing to inadequate rainfall, farmers have resorted to the use of improved drought-resistant crop varieties as opposed to the local varieties that can hardly survive drought conditions. This has allowed the maintenance of food production and income levels for many households. As Onyeneke and Madukwe [28] reported the development and adoption of the NERICA rice in West Africa is an example of this measure. They maintained that the rice variety possesses such traits as early maturity, weed tolerance, drought tolerance and is high yielding. Furthermore, Mutekwa [29] observed that many local farmers in Zimbabwe are adopting high-yielding and drought-resistant crop varieties like sorghum, millet and maize in place of the traditional varieties that are not well adapted to the changing climate. Similarly, Awoyinka [30] reports that local farmers in Oyo state are adopting improved cassava varieties distributed by Root and Tuber Extension Programme (RTEP) and Agricultural Development Programmes (ADP) to improve their productivity. The finding also confirms the report of Ozor et al. [24] that many local farmers in southern Nigeria use drought-resistant crop varieties to adapt to climate change.

The use of pest/disease resistant crop varieties has been able to safeguard crops against losses from pests and diseases attacks as many traditional crop varieties are known to be resistant to pests and diseases attacks. For example, it has been observed that many local farmers are planting improved cassava varieties that resist pest and disease attack. As Onyeneke and Madukwe [28] observed, such varieties in addition to providing protection against pest and disease attack offer other benefits like early maturity, high yield and reduced use of pesticides. This is in conformity with the report of Mortimore and Manvel [31] that many farmers in Ghana are adopting pest/disease – resistant crop varieties in groundnut, millet, maize, cassava and pigeon pea as coping measures to the changing climate.

Water conservation techniques have been identified as among the effective adaptation strategies against climate change. This is of various types such as the use of catchment tanks, sinking of wells and the collection of rainwater but all aim at supplementing the insufficient natural rainfall [31]. It has been observed that local farmers can harvest rainwater either in-situ or using storage systems. According to Ngigi [32] the former refers to collecting and utilizing rainwater directly on the soil profile and such techniques include the construction of bunds which is a common practice in Tanzania; while the latter refers to collecting rainwater in storage systems such as ponds, containers or tanks and using them later. Rockstrom [33] asserts that rainwater harvesting is a suitable means of agricultural water supply by upgrading rain-fed agriculture through in-situ soil moisture conservation and on-farm run-off storage for supplementary irrigation. They provide water and food security especially for people living in areas with limited water supply.

Planting deeper into the soil was also indicated as among the adaptation strategies to climate change in the study area. As a result of increased heat stress and heavy/scanty rainfall, local farmers have evolved the idea of planting their seeds/cuttings deeper into the soil to protect them from excessive heat, excessive moisture loss or being washed away by torrential rains. Some make ridges or mounds in order that the planting materials would be buried deep into the soil which will promote moisture retention and crop establishment. This technique helps to retain moisture in the soil especially when combined with mulching operations. However, some authors have described this practice under soil conservation techniques particularly tillage. The farm-level adoption of this practice is confirmed by a study carried out by Ozor et al. [24] which reports that farmers in southern Nigeria plant deeper in the soil in order to save their crops from adverse weather conditions.

Following increased weed infestation on farmlands, farmers presently have increased the frequency of their weeding operation so as to reduce competition between their crops and weeds as a response to climate change. Further, it helps to prevent pest and disease infestations on crops as weeds attract pests and encourage certain disease condition in plants. Some studies have confirmed this as a common adaptation strategy to climate change in the tropics. For example, Ozor et al. [24] reported that some farmers in the southern part of Nigeria are adapting to climate change through increased weeding of their farms.

Changing of planting/sowing/harvesting dates and changing of timing for land preparation has been confirmed as among the local strategies for adapting to climate change at the farm-level in the tropics. Following the variations in the rainfall pattern, shorter rainfall duration and prolonged dry season, farmers have developed the practice of changing their planting dates (planting early or late) depending on the crop and its requirements in order to protect their crops from failures. It has been discovered that temperature regime and rainfall patterns greatly influence not only the growth duration but also the growth pattern and productivity of crops. Extreme temperatures whether low or high for example cause injury to crops. In tropical regions for instance, high temperatures are constraints to rice production. The most damaging effect is on grain sterility [28].

According to Nguyen [34] considering the fact that temperature and other weather elements vary from month to month, it is possible to select the right date for crop establishment in such a way that the reproductive and grain filling phases of the crops fall into the months with suitable conditions for the crops to establish. Rosenzweig and Tubiello [35] submit that farmers have successfully adapted to the vagaries of weather in different regions by adjusting the timing of planting and harvesting operations. Also Mary and Majule [36] reported that farmers in Singida region of Tanzania start land preparation (locally known as *Kubelega*) early enough (mid-July) to avoid unnecessary competition for labour during the peak period which normally occurs soon after the onset of rains. Ozor et al. [24] also confirmed changing of planting / sowing / harvesting dates and timing of land preparation as among the local adaptation strategies to climate change in southern Nigeria.

The implication of this is that local farmers have been able to test and know the effective adaptation strategies to climate change in their area. However, better and more sustainable adaptation strategies should be introduced as it was observed that for many countries located in tropical regions, the potential benefits of low-cost adaptation measures such as changes in planting dates, crop mixes and cultivars are not expected to be sufficient to offset significant climate change damages Butt et al. [37].

4.3 Constraints to Adaptation to Climate Change

Data in Table 4 show that the major constraints to adaptation to climate change in the study area included; limited access to improved crop varieties (M = 1.95), high cost of farm labour (M = 1.80), inadequate financial resources to adapt (M = 1.80), high cost of diversification of enterprises (M = 1.78), lack of irrigation schemes (M = 1.66), high cost of improved crop varieties (M = 1.65), inefficient water harvesting methods (M = 1.63), high cost of improved livestock breeds (M = 1.59), high cost of construction of dams (M = 1.58), limited access to improved livestock breeds (M = 1.57), planting before rains result in crop failure (M = 1.57), limited availability of land (M = 1.53), high cost of land (M = 1.53), poor extension service (M = 1.52) and lack of government policy on adaptation (M = 1.50).

Table 3. Mean distribution of local adaptation practices to climate change (n= 108)

Local adaptation measures	M	S.D
Producing new crops	0.66	0.815
Producing new livestock	0.50	0.772
Diversification in crop production	0.73	0.846
Diversification in livestock production	0.68	0.834
Growing drought-resistant crop varieties	1.14*	0.941
Use of pest/disease resistant crop varieties	1.06*	0.964
Moving focus from crop to livestock production	0.26	0.540
Started non-farm activities	0.85	0.913
Out-migration from climate risk zones	0.64	0.795
Use of cover crops	0.65	0.817
Crop rotation	0.45	0.619
Intercropping	0.75	0.874
Adoption of zero tillage	0.28	0.565
Early planting	0.86	0.920
Reduction in number of livestock	0.35	0.633
Roof water harvesting	1.00*	0.946
Construction of earth dams	0.95	0.909
Construction of catchment tanks	0.96	0.955
Sinking more wells	1.06*	0.924
Afforestation initiatives	0.61	0.800
Laws against deforestation	0.55	0.751
Ground water harvesting	1.07*	0.951
Use of irrigation	0.87	0.906
Mulching operation	0.90	0.894
Cultivating in wetlands	0.77	0.854
Contour cropping across hills	0.44	0.705
Planting deeper into the soil to avoid heat stress	1.10*	0.960
Making bigger ridges/mounds	0.92	0.896
Making smaller ridges/mounds	0.26	0.606
Construction of drainage systems	0.83	0.931
Value addition	0.62	0.710
Cultivating on marginal lands	0.70	0.795
Increased weeding	1.29*	0.915
Changing planting dates	1.05*	0.930
Changing timing of land preparation	1.01*	0.951
Minimum tillage/zero tillage	0.36	0.679
Changing harvesting dates	0.92	0.906
Multiple cropping	0.70	0.807
Mixed farming	0.84	0.906
Relay cropping	0.58	0.906
Intercropping- main crops planted with subsidiaries at low densities	0.71	0.816
Changing from production of marketing of agricultural products	0.65	0.805
Prayers for God's special intervention	0.65	0.805
Construction of elevated homesteads	0.36	0.635
Abandoning crop production	0.16	0.554

**Effective adaptation strategies, Source: Field Survey, September 2010*

Adger et al. [38] reported that adaptation to climate change at the local, individual and community levels can be constrained by the lack of adequate financial resources. In field surveys and focus groups, farmers often cite the lack of adequate financial resources as an important factor that constrains their use of adaptation measures which entail significant investment, such as irrigation systems, improved or new crop varieties and diversification of farm operations [39]. Similarly, Appendini [40] posited that lack of resources may limit the ability of low-income groups to afford proposed adaptation mechanisms such as climate-risk insurance. Also, the finding is in line with the report that lack of government policies on adaptation has remained a serious limitation to effective climate change adaptation in most developing countries and this has limited the availability of infrastructure needed to enhance adaptation [32].

The findings that high cost of improved crop varieties and high cost of improved livestock breeds inhibit climate change adaptation are in agreement with the report of Bryan et al. [41] that lack of inputs constitutes constraints to adaptation to climate change in Africa.

Further, the finding that limited availability of land constrains effective adaptation to climate change confirms the report of Ozor et al. [24] that land constraint is among the problems that work against effective adaptation to climate change in the Southern part of Nigeria. Ngigi [32] also reported that inefficient water management techniques are among the factors that work against effective adaptation to climate change in sub-Saharan Africa.

4.4 Factor Analysis of Constraints to Adaptation to Climate Change

Specific issues which contribute to financial constraints to climate change in the study area as shown in Table 5 include high cost of diversification of enterprise (0.85), inadequate financial resources to adapt (0.83), high cost of labour (0.83), high cost of improved crop varieties (0.78) and poor extension service (0.66). Inadequate financial resources to adapt might make it difficult for the farmers to access

Table 4. Mean distribution of constraints to adaptation to climate change

Constraints	M	S.D
Limited access to improved crop varieties	1.95*	1.376
Limited access to improved livestock breeds	1.57*	1.280
High cost of improved livestock breeds	1.59*	1.392
High cost of improved crop varieties	1.65*	1.338
Non-availability of processing facilities for value chain addition	1.44	1.204
High cost of diversification of enterprise	1.78*	1.317
Use of zero tillage encourages weed growth, pest and disease attack	1.27	1.175
Use of zero tillage encourages erosion	1.31	1.275
Planting before rains result to crop failure	1.57*	1.338
Lack of irrigation schemes	1.66*	1.358
Inefficient water harvesting methods	1.63*	1.297
High cost of constructing dams	1.58*	1.365
Poor access to information relevant to adaptation	1.36	1.244
Inadequate financial resources to adapt	1.80	1.369
Inadequate knowledge on how to cope	0.91	1.215
High cost of farm labour	1.80*	1.369
Poor response to crises related to climate change	1.30	1.197
Lack of government policy on adaptation	1.50*	1.333
Limited availability of land	1.50*	1.311
High cost of land	1.53*	1.361
Poor land ownership system	1.25	1.317
Low income level	1.32	1.342
Poor extension service	1.52*	1.282
26 Lack of access to weather forecast	1.29	1.234
Lack of access to weather forecast	1.29	1.234

** Perceived constraints to climate change adaptation, Source: Field Survey September 2011* farm labour and improved crop varieties because of their high costs. It could also make it hard for them to access extension service especially when it is provided by a private extension agency since they have to pay. Further, inadequate financial resources when viewed from the government perspective might lead to poor funding of public extension service which would bring about poor extension service or coverage in the rural areas. All these will together increase the cost of diversification of enterprise which most resource-poor farmers cannot afford. Consequently, their vulnerability to climate change will remain high. Ngigi [32] reported that inadequate financial resources have made it difficult for farmers in developing countries to contend effectively with climate change.

Factors that classified under government failure as shown in Table 5 include poor land ownership system (0.81), low income level (0.80), use of zero tillage encourages weed growth, pest and disease attacks (0.73), poor response to crises related to climate change (0.67) and limited availability of land (0.61). Poor responses to crises related to climate change by the government could lead to the absence or ineffectiveness of regulations on land ownership, thus bringing about poor land ownership systems and limited availability of land. Poor land ownership systems and limited availability of land could discourage agricultural production which will result to low income level among farmers as a result of poor access to adequate land for farming. Furthermore, poor land ownership system could make farmers adopt zero tillage which encourages weed growth, pest and disease attacks on crops at the short run as a coping strategy to climate change. However, Soane et al. [42] report that the switch turns out to be useful after five years of adoption as it reduces weed, pest and disease infestation and thus lower expenses.

Finally, factors which fell under technical constraints to climate change as shown in Table 5 include lack of access to weather forecast (0.70), planting before the rains resulting in crop failure (0.68) and inadequate knowledge on how to cope (0.65). Lack of access to weather forecasts can contribute to inadequate knowledge on how to cope among rural farmers.

Table 5. Factor analysis of constraints to adaptation to climate change

Constraints	Financial constraints	Government failures	Technical constraints
Limited access to improved crop varieties	0.75	0.42	0.28
Limited access to improved livestock breeds	0.52	0.41	0.52
High cost of improved livestock breeds	0.48	0.58	0.42
High cost of improved crop varieties	0.78	0.38	0.07
Non-availability of processing facilities for value addition	0.43	0.45	0.61
High cost of diversification of enterprise	0.85	0.28	0.13
Use of zero tillage encourages weed growth, pest attack	0.35	0.73	0.34
Use of zero tillage encourages erosion	0.31	0.69	0.44
Planting before the rains result to crop failure	0.04	0.05	0.68
Lack of irrigation schemes	0.65	0.52	0.28
Inefficient water harvesting methods	0.71	0.47	0.20
High cost of constructing dams	0.62	0.50	0.18
Poor access s to information relevant to adaptation	0.47	0.61	0.30
Inadequate financial resources to adapt	0.83	0.24	0.17
Poor extension service	0.66	0.29	0.39
Lack of access to weather forecast	0.05	0.08	0.70
Inadequate knowledge on how to cope	0.04	0.37	0.65
High cost of farm labour	0.83	0.32	0.19
Poor responses to crises related to climate change	0.30	0.67	0.05
Lack of government policies on adaptation	0.53	0.48	0.42
Limited availability of land	0.31	0.61	0.22
High cost of land	0.46	0.67	0.18
Poor land ownership system	0.28	0.81	0.20
Low income level	0.04	0.80	0.14

Extraction method: Principal factor model with varimax rotation

This however, might lead farmers to not having adequate information or prediction regarding the start or end of rains. Farmers, lacking information on when best to plant regarding the start and end of rains might end up planting before the rains which will lead to the failure of their crops as a result of drought.

5. CONCLUSION AND RECOMMENDATIONS

The study sought to ascertain the indigenous practices for climate change adaptation among rural households in Imo State, Nigeria. Specifically, it examined the awareness level of respondents to climate change, the local adaptation practices for climate change adopted by the respondents and the constraints to adaptation to climate change in the study area. Results show that the majority (78.3%) of the respondents were aware of climate change while about 41% knew very little about climate change. The most significant local adaptation practice to climate change in the study area was growing drought-resistant crop varieties. The most significant constraint to adaptation to climate change was limited access to improved crop varieties. The constraint factors classified under financial factors, technical factors and government failures. It is therefore recommended that the awareness level of local people about climate change should be increased and this can be done through the involvement of the extension agency and mass media in the dissemination of information on climate change. Telecommunication companies such as MTN, ZAIN and GLO should be involved as well as in dissemination of information on climate change. This will help to improve the knowledge of local people on climate change and thus their adaptive capacity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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