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Challenges faced by cocoyam farmers in adapting to climate change in Southeast Nigeria

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ABSTRACT

The study examined the challenges faced by cocoyam farmers in adapting to climate change in Southeast, Nigeria. Three hundred and eighty-four respondents selected through multi-stage sampling technique were used for the study. Data were collected using structured questionnaire and interview schedule and analysed using both descriptive and inferential statistical tools. Findings showed that majority were females (67%), married (92%) and maintain average household size of 6 persons and a mean age of 51 years. They were mainly primary (32%) and secondary (34%) school certificate holders with farming (77%) as their major occupation. The major cropping pattern practiced was mixed farming with cassava (63%) and maize (58%) as the major crops cultivated by the farmers. Majority of the farmers owned farms of one hectare and below accessed mainly through inheritance (76%) and labour sourced mainly through hiring (50%). Most (81%) of the farmers have spent more than ten years in farming. Climate change information was accessed mainly through their personal experience (64%), radio (42%) and fellow villagers (39%). The study identified eight major challenges faced by cocoyam farmers in adapting to climate change namely Lack/high cost of farm inputs and low soil fertility (Factor 1), Land and labour constraints (Factor 2), Poor access to information and ineffectiveness of cooperatives (Factor 3), lack of/poor access to fund and credit facilities and poor government support (Factor 4), lack of improved varieties of cocoyam (factor 5), poor value attached to cocoyam (Factor 6), poor infrastructural capacity and technology know-how (Factor 7) and Transportation constraint (Factor 8). Analysis of variance identified significant variations in the challenges faced by cocoyam farmers in the study area. The study recommends enrollment in cooperatives and revitalizing existing cooperatives, re-orientation of farmers on the benefits of cocoyam and increased used of climate change information sharing using mobile phones as possible ways of alleviating the challenges.

1. Introduction

Both natural and human systems in all continents have experienced the impacts of climate change though the evidence is more pronounced in natural systems (IPCC, 2014). Changes in climate and its impacts come as a result of varying changes in

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weather parameters over time, (Nzeh et al., 2015). These no doubts through various manifestations have adverse effect on man and his activities, especially agriculture. The IPCC Fourth Assessment Report observes that Africa is one of the most vulnerable (due to its physical and socioeconomic characteristics) continents to the changes in climate. This is mainly as a result of their low adaptive capacity and numerous stressors. It also noted several African countries will experience severe decrease as much as 50% in their agricultural production by the year 2020 with worst impact on subsistence farmers, thereby adversely affecting the continent's food security. Similarly, the Food and Agriculture Organisation (FAO, 2010) noted that climate change militate against the progress made in African's economy as huge amount of resources are been invested in adaptation issues. Thus, the resource base of farmers are likely to be affected, this may worsen the situation and create food insecurity problems.

In Nigeria, the impact of this change in climate are becoming more intense, this is occasioned by the increase in flooding, drought and general rainfall fluctuation experienced in the country in the past few years. Specifically, in cocoyam production, Ukonze (2012) identified many effects of climate change on cocoyam production ranging from reduction in nutritional value, taste and quality to low yield which could lead to extinction of cocoyam from crop mixture if nothing is done. The climate is no longer predictable as in the olden days where rainy and dry seasons are succinctly separated. Unfortunately, majority of the farmers still rely on the fluctuating climate signals for the farming activities resulting in heavy loss of planted crops. Nigerian Meteorological Agency, (NIMET, 2010, 2012) stated that "if the present trend of climate variability continues, it is likely that the frequency and intensity of weather-related disasters may increase in the years ahead". Observations have shown that the climate variability trend has continued to progress over the years. This highlights the cogent need of developing effective and sustainable mitigation and adaptation measures in the country. "Although Nigeria, like other developing countries, is not required under the current global climate change negotiations to take on emission reduction commitments (mitigation), it nevertheless has to adapt to the expected impacts of anticipated climate change", (Oladipo, 2010). This makes adaptation the major response to climate change in Nigeria. Varying adaptation options have been identified by different researchers in different parts of the country, as well as those developed by the farmers through experience over the years.

Eriksen et al. (2010) noted that though adaptation can significantly minimize the undesirable impacts of climate change, enough attention is yet to be paid to the outcome of these adaptation practices as regards sustainability. They explained "that in some cases, what seems to be a successful adaptation strategy to climate change may, in fact, undermine the social, economic and environmental objectives associated with sustainable development for instance strategies or policies that make sense from one perspective, or for one group, may at the same time reduce the livelihood viability or resource access of other groups; likewise, an eagerness to reduce climate risk through specific technologies or infrastructural changes may sometimes lead to the neglect of other environmental concerns, such as biodiversity, hence, adaptation can have unintended negative effects both on people and on the environment" (Næss et al., 2005; Eriksen and O'Brien, 2007; Eriksen and Lind, 2009).

In addition, majority of the studies relating to agriculture and climate change in Africa concentrated on impacts and corresponding coping/adaptation strategies as well as projections with less attention given to the challenges of adaptation (Enete and Amusa, 2010). These incomplete assessments are not suitable enough to provide comprehensive insight into farmers adaptation constrains. To effectively achieve food security goals, it is important to also assess these areas of agriculture and climate change. Furthermore, "the vulnerability of agriculture is not determined by the nature and magnitude of environmental stress like climate change alone, but by the combination of the societal capacity to cope with and/or recover from environmental change" (Wisner et al., 2004).

Against the foregoing backdrop, this study assessed the challenges cocoyam farmers faced in climate change adaptation in Southeast Nigeria. It described the socio-economic characteristics of the cocoyam farmers, examined sources of climate change information and differences in challenges faced by cocoyam farmers in adapting to climate change in their different states.

1.1. Conceptual framework

Arokoyu and Umeduji (2004) stated that the environment means all the external conditions influencing the development of any living organism. This involves the circumstances, objects, or conditions by which the living organism is surrounded, implying that anything outside of man himself is his environment. Similarly, Adisa et al., 2006 opined that the environment is simply the physical space and the surroundings in which man lives or resides. This includes all living organism, air, water, soil and all other resources necessary to sustain life. This is to say that all things outside man are his environment. Human history has it that man in his struggle to survive and in his quest to satisfy his increasing range of needs and desires has continued to inflict change in his environment, this is heightened by the growing human population and technology advancement. Man's activities in his environment result in changes in the natural environment such that the natural environment is becoming difficult to define or explain. On the other hand, man's environment on its own exerts some influences on man and his activities making the relationship between man and his environment a two-way process. Notably, man does not allow the changing environment to cripple his activities, in his struggle to survive he invent ways to adapt (adaptation measures) his activities (example farming activities) to the changing environmental conditions.

Arokoyu and Umeduji (2004) proposed three notable theories on man-environment interaction namely; environment determinism, environment possibilism and environment probabilism. The theory of environmental determinism predicated on the basic idea that the natural environment absolutely defines the locus of man's action. Human being is seen as a mere

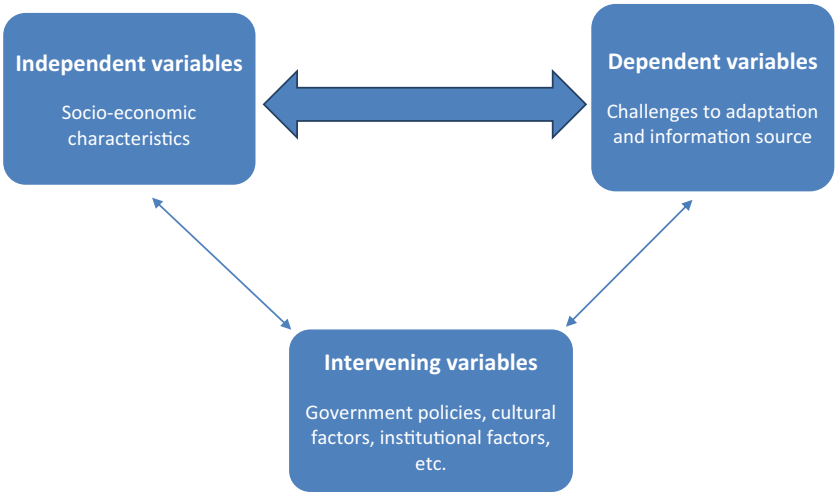

Fig. 1. Schema for analysing the constraints faced by cocoyam farmers. Adapted from: Adedoyin and Adeokun (2004) Conceptualization of theoretical framework for a proposed study.

product of the earth's surface, which implies that he is a function of the environment, he depends on the resources or opportunities offered by the environment and at the same time is confronted by hurdles or constraints posed by the environment. The theory of environmental possibilism holds that man is the master of the environment. The environment simply offers a wide range of opportunities from which man uses his initiative to choose. Man uses his ingenuity to confront, circumvent or scale any hurdle or limitation which nature or environment poses. At will, he can create new landscapes, irrigate his farm or, genetically develop the kind of crop that suits his environment. He can transform nature to his own advantage and nothing is impossible to man in the absolute sense. The environmental probabilism theory states that the physical environment offers some opportunities that might determine probable courses of action, but the onus to make a decision accepting or modifying any course of action ultimately lies with man. This is to say that man's interaction with his environment is a two-way process involving the influences exerted by man on his environment and the influences exerted by the environment on man, his mode of behavior and on his activities.

This research work is based on the environmental probabilism theory. This theory assumes a relationships between man and his environment. Man's environment exerts changes on man and on the other hand, the activities of man exert changes on the environment. One of the major products of this changing environment is the change in climate. Due to the changes brought about by man's activities in the level of greenhouse gases (GHG) in the atmosphere, the climatic conditions also undergo changes. As the volume of these greenhouse gases (e.g. carbon dioxide, methane and chlorofluorocarbons) increase, the temperature of the earth's surface rise gradually. It is this rise in the earth's temperature that causes climate change. This change in climate has numerous effects on man's activities especially agricultural activities. This research is aimed at analysing the challenges faced by man (cocoyam farmers) as they adapt to climate change effects. In the face of rising environmental issues that poses serious threat to human life and sustenance, research work that can strengthen the adaptive capacity of man (particularly farmers) becomes very necessary. More so, in a predominantly agrarian country like Nigeria, the most important natural resources are Land (soil and water), vegetation and animals (wildlife and domestic livestock). Human activities depend on these resources, which determine the living standard of the vast majority of the population (especially the rural people). It is very necessary that these resources are preserved to ensure continued sustenance of human life.

The conceptual framework is based on the premise that climate change affects Cocoyam production thereby prompting farmers to adapt to this change. It conceptualized that in adapting to climate change, farmers face a lot of challenges which can alter their successful adaptation. The conceptualization assumes that relationship between the dependent (challenges to adaptation and source of information on climate change) and independent variables (age, marital status, level of education, gender, farming experience, household size, farm size, major occupation, farming activities done and monthly income, major crop cultivated, method of land acquisition, major source of land) is strong, but a weak relationship exist between the intervening variables (government policies, availability of infrastructural facilities, cultural factors, institutional factors and attitude of cocoyam farmers towards change) and the independent variables. The Relationship between the various variables (Dependent, Intervening and Independent variables) are expressed in Fig.1.

1.2. Hypothesis of the study

There is no significant difference in climate change adaptation challenges faced among cocoyam farmers in Southeast Nigeria.

2. Methodology

The study area is Southeast Nigeria which comprises of Abia, Ebonyi, Imo, Anambra, and Enugu state. "The zone is located within latitudes 4° 47′ 35″N and 7° 7′ 44″N, and longitudes 7° 54′ 26″E and 8° 27′ 10″E in the tropical rain forest zone of Nigeria, with mean maximum temperature of 27 °C, and total annual rainfall exceeding 2500 mm" (Ezemonye and Emeribe, 2012). "It is mainly agrarian and inhabitants depend more on land resources, due to its dense population averaged to about 1000 people/Km^2. The climate of Southeast Nigeria is influenced by the three major air masses namely; the equatorial Maritime, the Equatorial Estuaries and the Tropical continental air masses" (Mbakwe et al., 2004). Rainfall is the key climatic variable. Loamy soil is the predominant soil type while mixed cropping is the major cropping system, (Unamma et al., 2004). Locally manufactured farm tools are still predominantly used in the area.

The population of this study comprises all farmers growing cocoyam who have lived in the Southeast Nigeria for at least twenty years. Selection of sample for the study was done using multi-stage sampling technique. First, three states namely Anambra, Imo and Enugu were randomly selected from the five states in the zone. Secondly, from each of the selected state, two agricultural zone were randomly selected. In Anambra state, Awka and Onitsha zone were selected, in Imo state, Orlu and Okigwe zone were selected while in Enugu state, Udi and Nsukka zones were selected.

The third stage comprises random selection of two blocks from each selected zone. The blocks selected were Dunukofia, Awka south, Ihiala, Ekwusigo, Onuimo, Isiala Mbano, Njaba, Orsu, Udi, Ezeagu, Uzouwani and Igboetiti. In the fourth stage, from each selected block, two circles were randomly chosen. The circles selected were Ukpo, Abagana, Umuawulu, Nise, Uli, Okija, Ozubulu, Ihembosi, Umunaa, Okwelle, Osuowerre 1& 2, Osuachara, Nkume, Ugbeleakah, Ebenato, Awoidemili, Amaokwe, Obiaoma/Nsude, Oghe/Iwollo, Obinaofia, Nkporogwu, Ogwurugwu, Ukehie and Ozara. The sampling frame is the list of all cocoyam farmers that have lived in the selected circles for at least twenty years. Traditional rulers, village and clan heads and chiefs, extension agents and key informants helped in the compilation of this list. A sample size of 384 respondents were proportionately selected for the study, this marks the fifth stage.

Primary data was used for this study which was collected using a structured questionnaire and structured interview schedule. In-depth interview and Focused Group Discussion was used to argument structured questionnaire and interview schedule. Secondary data was also used to complement the primary data. Analysis of variance was used to test the hypothesis while varimax rotated factor analysis and descriptive statistical tools were used to achieve the objectives. Scheffe Post Hoc multiple comparison test was used to identify the area of variation.

3. Results and discussion

3.1. Socio-economic characteristics of the cocoyam farmers

Findings in Table 1 showed that the majority of the respondents were females (67%), married (92%) and maintain average household size of 6 persons. Mean age was 51 years indicating that they are old enough to have experienced climate vagaries and as could give credible responses on climate change issues. They were mainly primary (32%) and secondary (34%) school certificate holders. Their major occupation is farming (77%) with major cropping pattern as mixed farming and cassava (63%) and maize (58%) as the major crops cultivated by the farmers. Majority of the farmers owned farms of one hectare and below while farm lands were acquired mainly through inheritance (76%) and labour sourced mainly through hiring (50%). Most (81%) of the farmers have spent more than ten years in farming.

3.2. Climate change information source

Results in Table 2 show that farmers accessed climate change information through their personal experience (64%), radio (42%) and fellow villagers (39%). It was observed that the potentials of mobile phones in disseminating information is yet to be harnessed as information on climate change is rarely passed through this medium. Farmers mainly see mobile phones as a means of sharing personal information.

3.3. Challenges faced by cocoyam farmers in adapting to climate change

Principal component analysis identified eight units with Eigenvalues of above 1, explaining 24.3%, 9.071%, 6.182%, 5.169%, 4.608%, 3.934%, 3.590% and 3.096% of the variance respectively. The eight units represent the eight main constraints faced by cocoyam farmers in adapting to climate change and explained 59.98% of the variance. These eight factors are namely: Lack/high cost of farm inputs and low soil fertility (Factor 1), Land and labour constraints (Factor 2), Poor access to information and ineffectiveness of cooperatives (Factor 3), lack of/poor access to fund and credit facilities and poor government support (Factor 4), lack of improved varieties of cocoyam (factor 5), poor value attached to cocoyam (Factor 6), poor infrastructural capacity and technology know-how (Factor 7) and Transportation constraint (Factor 8).

For the individual components that made up each factor, only those with loadings of 0.50 and above were considered significant. The items that amplified factor one (lack/high cost of farm inputs and low soil fertility) includes high cost of farm inputs (0.834), scarcity and poor access to fertilizer (0.589), shortage of planting material (0.620), high cost of fertilizers

Table 1
Socio-economic characteristics of cocoyam farmers in southeast Nigeria.

S/N	Variable	Frequency	Percentage	Mean
1	**Gender**			
	Male	128	33	
	Female	256	67	
2.	**Age (years)**			**51**
	21–40	96	25	
	41–60	202	52	
	61–80	83	22	
	Above 80	3	1	
3	**Marital status**			
	Single	29	8	
	Married	355	92	
4	**Number of years spent in school**			**10**
	0	31	8	
	1–6	124	32	
	7–13	132	34	
	14–19	90	24	
	Above 19	9	2	
5	**Monthly income (₦)**			
	0–20,000	153	40	
	21,000–40,000	89	24	
	41,000–60,000	82	21	
	61,000–80,000	35	9	
	81,000–100,000	17	4	
	Above 100,000	8	2	
6	**Household size**			**6**
	≥5	149	39	
	6–10	214	55	
	11–15	19	5	
	16–20	2	1	
7	**Major occupation**			
	Farming	298	77	
	Non-Farming	86	23	
8	**Major cropping pattern**			
	Mixed cropping	273	71	
	Sole cropping	19	5	
	Both	92	24	
9	**Major crop cultivated***			
	Yam	202	52	
	Cassava	243	63	
	Maize	224	58	
	Vegetables	208	54	
	Cocoyam	189	49	
	Plantain	141	36	
	Others (sweet potatoes, pineapples,	34	10	
10	**Farm size (Ha)**			**0.85**
	<1	247	64	
	1–2	102	27	
	Above 2	40	9	
11	**Method of land acquisition**			
	Inheritance	289	76	
	Purchase	14	3	
	Lease/rent	72	19	
	Others (to pay debt, gift)	9	2	
12	**Major source of labour**			
	Family members	111	29	
	Hired labour	192	50	
	Others (Friendship, to pay debt, to show appreciation for favours received	80	21	
13	**Farming experience (Years)**			**21**
	1–10	71	19	
	11–20	91	23	
	21–30	168	44	
	31–40	37	10	
	Above 40	17	4	

Source: Field survey, 2015.
* Multiple responses.

Table 2
Percentage distribution of cocoyam farmers according to climate change information source.

Variable	Frequency	Percentage
Sources of information on climate change		
Newspaper	45	11.7
Television	114	29.7
Extension agent	126	32.9
Fellow villagers	150	39.1
Radio	162	42.2
Personal experience	249	64.8
Mobile phones	46	12.0
Internet	13	3.4

Source: Filed survey, 2015.

(0.531) and low soil fertility (0.872). The farmers during the Focused group discussion complained of the high cost of fertilizers in their zone. According to them, sometimes it is not even seen at all, only the adulterated ones are available in most markets. On the e-wallet of the Federal government, the farmers said though it has improved fertilizer distribution but not to a significant level.

Under factor two (Land and Labour constraint), the constraining variables against climate change adaptation are high cost of labour (0.723), poor access to land (0.556), shortage of cultivable land for production expansion (0.652) and land tenure

Table 3
Factor analysis showing the constraints faced by cocoyam farmers in adapting to climate change.

S/N	Constraints	Component								
		1	2	3	4	5	6	7	8	Communalities
1	Lack of government support	0.299	0.245	0.028	**0.512**	0.115	0.190	0.330	0.193	0.**608**
2	Lack of improved cultivars of cocoyam	0.292	0.357	−0.201	0.176	**0.601**	0.139	0.417	0.058	**0.674**
3	Lack of disease/pest resistant cultivars	0.281	0.346	0.211	0.060	**0.584**	0.055	0.092	0.305	**0.536**
4	High cost of farm inputs	**0.834**	0.042	0.405	0.376	0.263	−0.050	0.086	−0.158	**0.370**
5	Lack of/ access to fund to improve production, processing and marketing	0.481	0.048	−0.025	**0.53**6	0.191	0.221	−0.231	−0.068	**0.567**
6	High cost of labour	0.450	**0.723**	−0.044	0.133	−0.382	0.150	−0.358	−0.035	**0.669**
7	Scarcity and Poor access to fertilizer	**0.589**	0.190	0.080	0.068	−0.244	0.169	−0.398	0.028	**0.641**
8	Shortage of planting materials	**0.620**	0.187	−0.091	0.067	−0.217	−0.064	−0.214	0.121	**0.544**
9	Poor of improved storage facilities	0.348	0.060	−0.386	0.082	−0.163	−0.193	−0.135	0.328	**0.650**
10	High cost of fertilizers	**0.531**	0.039	−0.177	−0.335	−0.041	0.051	−0.151	0.085	**0.461**
11	Poor knowledge of using improved farm production method	0.230	0.163	0.200	−0.019	0.306	0.178	−0.210	−0.334	**0.629**
12	Limited range of varieties	0.366	0.149	0.010	0.147	**0.534**	0.459	0.115	0.234	**0.645**
13	Poor access to information sources	0.431	0.162	−0.271	0.113	0.108	0.244	−0.151	0.205	**0.531**
14	Lack of mechanized farming	0.434	0.051	−0.034	−0.446	0.178	0.337	**0.556**	0.070	**0.641**
15	Low soil fertility	**0.872**	0.199	0.153	0.011	0.271	0.032	−0.073	−0.125	**0.486**
16	Poor state of feeder roads	0.495	0.079	−0.123	−0.326	0.213	−0.228	−0.032	**0.589**	**0.617**
17	Poor access to land	0.495	**0.556**	0.081	0.084	−0.032	−0.102	0.007	−0.085	**0.695**
18	Far distance of fertile farm lands from residential homes	0.398	0.426	0.052	0.206	−0.072	−0.083	0.146	**0.579**	0.**720**
19	High cost of transportation	0.484	0.098	−0.259	−0.185	−0.100	0.047	0.350	**0.598**	**0.568**
20	Shortage of cultivable land for production expansion	0.419	**0.652**	−0.184	0.098	−0.281	−0.088	0.073	0.006	**0.582**
21	Land tenure system problem	0.465	**0.569**	−0.156	−0.196	−0.225	−0.218	0.050	0.072	**0.493**
22	Poor knowledge of extension agent on adapting cocoyam to climate change	0.438	0.136	0.030	−0.092	−0.155	−0.026	**0.501**	0.287	**0.632**
23	Lack of sufficient farming experience to tackle some climate exigencies	0.338	0.150	0.014	0.103	−0.178	0.124	**0.534**	0.296	**0.593**
24	Lack of extension contact	0.492	0.136	**0.627**	−0.431	0.170	0.130	0.129	0.014	**0.618**
25	Poor access to weather forecast information	0.450	−0.436	**0.576**	0.029	−0.187	−0.148	0.110	0.020	**0.636**
26	Low price of cocoyam in the market	0.382	0.015	0.474	0.112	0.151	**0.525**	0.100	0.133	**0.555**
27	Lack of collateral to secure available credit facilities	0.252	0.448	0.330	**0.691**	−0.177	0.189	0.088	0.050	**0.747**
28	Low demand for crop	0.236	0.312	0.410	0.101	0.118	**0.694**	0.045	0.103	**0.625**
29	Ineffectiveness of existing cooperative societies in my area	0.425	0.234	**0.544**	−0.355	0.098	0.112	0.233	−0.053	**0.559**
30	Poor recognition of cocoyam as food	0.216	0.280	0.410	0.232	0.183	**0.577**	0.064	0.322	**0.657**
31	Old age affects my cocoyam farming activities	0.445	0.357	0.085	0.005	0.256	−0.301	0.005	0.003	**0.587**
32	Nonexistence of cooperative societies in my area	0.417	0.401	**0.691**	0.164	0.248	−0.339	−0.028	−0.198	**0.676**
	Eigen vale	**8.03**	**2.993**	**2.040**	**1.706**	**1.521**	**1.298**	**1.185**	**1.022**	
	Percentage variance	**24.335**	**9.071**	**6.182**	**5.169**	**4.608**	**3.934**	**3.590**	**3.096**	
	Cumulative percentage	**24.335**	**33.406**	**39.588**	**44.757**	**49.364**	**53.298**	**56.888**	**59.984**	

system problem (0.579). This result is supported by Deressa (2008) which reported that shortage of farm labour is a major barrier to climate change adaptation. Though farmers in the study area have relatively good number of household to supply farm labour, they complained that their children are not interested in farm work and as such abandons it to search for with collar job. Also, farmers complained that even when they want to try some of the adaptation measures available to them; they are constrained by limited available land. Leasing/renting has become expensive that it is no longer profitable to do. Benhin (2006) noted that farm size facilitates the speed of adoption of adaptation measures to climate change.

Under factor 3 (poor access to information and ineffectiveness of co-operatives), the specific constraining variables against climate change adaptation are lack of extension agent contact (0.627), poor access to weather forecast information (0.576), ineffectiveness of existing co-operative societies in the area (0.544) and non-existence of co-operatives in my area (0.691).“Information problems could pose serious challenges to the farmers coping strategies as they may not be aware of recent developments regarding climate change adaptations and the necessary readjustments needed” (Enete et al., 2011). In addition, “a lack of adaptive capacity due to constraints on resources like information may result in further food insecurity” (Mark et al., 2008).

The constraining variables that loaded high under factor 4 (lack of/access to fund & credit facilities and government support) are lack of government support (0.512), lack of access to fund to improve production, processing and marketing (0.536) and lack of collateral to secure available credit facilities (0.691). “Lack of access to credit or saving and adequate information about climate change are some of the major problems encountered by farmers in adapting to climate change in Africa’ (Benhin, 2006). Enete et al. (2011) noted that “with limited income (poverty), the acquisition of necessary facilities will be difficult, these facilities may not only be costly but may also appear scarce for poor farmers”. This underscores the problem of lack of access to farmers and suggests the urgent need to improve farmer’s access to credit facilities. On the other hand, (Emodi et al., 2014) reported that lack of government constitutes a major constraint to cocoyam production in Imo State.

Factor 5 (lack of/poor access to improved varieties) comprises of lack of improved cultivars of cocoyam (0.601), lack of disease/pest resistant cultivars (0.584) and limited range of varieties (0.534). The use of improved variety of crops could serve as an effective adaptation measure as some of them are tolerant and resistant to climate change effects, (Downing et al., 1997; Enete et al., 2010).

Under factor 6 (low value attached to cocoyam), the constraining variables to climate change adaptation are low demand for cocoyam (0.694), low price of cocoyam in the demand (0.525) and poor recognition of cocoyam as food (0.577).

The factors that magnified factor 7 (poor infrastructural capacity and technological knowledge) are lack of mechanized farming (0.556), poor knowledge of extension agent on adapting cocoyam to climate change (0.501) and lack of sufficient farming experience to tackle climate exigencies (0.534)

Under factor 8 (Transportation constraint), the factors that loaded high are poor state of feeder roads (0.539), far distance of fertile farm lands from residential homes (0.579) and high cost of transportation (0.598). Onwubuya and Ajani (2012) identified poor access to good roads as one of the major constraints facing cocoyam farming (Table 3).

3.4. Test of hypothesis

There is no difference in climate change adaptation challenges faced among cocoyam farmers in Southeast Nigeria (Table 4).

Analysis of variance was to check for significant differences in challenges to climate change adaptation among cocoyam farmers in the study area. Statistical significant difference exist at $p < 0.05$ level : $f(2, 381) = 10.411$, $p = 0.000$. In addition, f-tab value (7.530) was less f-cal value (10.411) at 0.05. This confirmed that significant differences exist in the challenges faced by cocoyam farmers in the study area.

The effect size calculated using eta squared method was 0.05 which according to Cohen (1988) would be classified as a small effect size. It could, therefore, be said that despite reaching statistical significant, the mean scores between the groups (states) was small.

$$\text{Eta squared} = \frac{\text{Sum of squares between groups}}{\text{Total sum of squares}}$$

$$\text{Eta squared} = \frac{4795.453}{92544.289} = 0.05181$$

However, the sources of these differences with respect to the variables need to be verified further. This was done using a Multivariate analysis of variance. A multivariate analysis of variance was chosen instead of conducting a series of ANOVA

Table 4
Analysis of variance in the challenges faced by cocoyam farmers in Southeast Nigeria.

Sources of variation	Sum of Squares	Df	Mean Square	F-cal	F-tab	Sig.
Between Groups	4795.453	2	2397.727	10.411	7.530	0.000
Within Groups	87748.836	381	230.312			
Total	92544.289	383				

Table 5
Multivariate analysis of variance (MANCOVA).

Constraints faced by cocoyam farmers	Sum of Squares	Df	Mean Square	F	**Sig.**	Partial eta squared
Poor access to land	2.099	2	1.049	1.059	0.348	0.006
Lack of access to fund to improve production,processing and marketing activities	7.130	2	3.565	4.512	0.012	0.023
High cost of labour	8.974	2	4.487	5.627	0.004	0.029
Lack of extension contact	26.083	2	13.042	11.251	0.000	0.056
Poor knowledge of extension agent on adapting cocoyam to climate change	7.078	2	3.539	3.577	0.029	0.018
High cost of fertilizers	1.333	2	0.667	0.837	0.434	0.004
Scarcity and Poor access to fertilizer	1.880	2	0.940	10.356	0.259	0.007
High cost of farm inputs	3.161	2	1.581	2.411	0.091	0.012
Lack of improved cultivars of cocoyam	16.797	2	8.398	11.868	0.000	0.059
Lack of disease/pest resistant cultivars	16.005	2	8.003	11.925	0.000	0.059
High cost of transportation	12.521	2	6.260	7.819	0.000	0.039
Poor state of feeder roads	27.203	2	13.602	13.886	0.000	0.068
Shortage of planting materials	7.380	2	3.690	4.441	0.012	0.023
Lack of government support	2.661	2	1.331	1.495	0.226	0.008
Far distance of fertile farm lands from residential homes	17.021	2	8.510	8.933	0.000	0.045
Poor knowledge of using improved farm production method	11.411	2	5.706	6.999	0.001	0.035
Low demand for crop	59.911	2	29.956	29.121	0.000	0.133
Low price of cocoyam in the market	76.938	2	38.469	38.258	0.000	0.167
Poor of improved storage facilities	52.755	2	26.378	31.020	0.000	0.140
Low soil fertility	28.562	2	14.281	17.714	0.000	0.085
Limited range of varieties	12.505	2	6.253	8.501	0.000	0.043
Land tenure system problem	12.349	2	6.174	7.108	0.001	0.036
Shortage of cultivable land for production expansion	22.333	2	11.167	11.804	0.000	0.058
Lack of mechanized farming	11.266	2	5.633	5.664	0.004	0.029
Poor recognition of cocoyam as food	43.286	2	21.643	21.950	0.000	0.103
Old age affects my cocoyam farming activities	30.083	2	15.042	14.440	0.000	0.070
Nonexistence of cooperative societies in my area	34.943	2	17.471	14.509	0.000	0.071
Ineffectiveness of existing cooperative societies in my area	61.849	2	30.924	24.345	0.000	0.113
Lack of collateral to secure available credit facilities	5.688	2	2.844	1.966	0.141	0.010
Existence of some traditional believes and practices that hinders effective adaptation	67.193	2	33.596	24.866	0.000	0.115
Poor access to information sources	1.474	2	0.737	0.927	0.397	0.005
Lack of sufficient farming experience to tackle some climate exigencies	4.083	2	2.042	2.011	0.135	0.010
Poor access to weather forecast information	6.161	2	3.081	2.189	0.113	0.011

separately for each dependent variable (constraint) to avoid the risk of an inflated Type 1 error. ‘‘Conducting a whole series of analyses stand the risk of an inflated Type 1 error, this implies that the more analyses one runs, the more likely you are to find a significant result, even if in reality there are no differences between the groups”, (Pallant, 2010). Using MANOVA controls or adjusts for this increased risk of a Type 1 error.

A one-way between-groups multivariate analysis of variance was done to identify the specific constraints that differ. Thirty-three dependent variables were used while the independent variable were the three states used for the study. To further minimize the chance of a Type one error, a higher alpha level was set. This was done by applying a Bonferroni adjustment which gave a new alpha value of 0.0015. Therefore, only probability value (Sig) of less than 0.0015 were considered significant.

The variables that significantly differs were lack of extension contact, lack of improved cultivars of cocoyam, lack of disease/pest resistant cultivars, high cost of transportation, poor state of feeder roads, far distance of fertile farm lands from residential homes, poor knowledge of using improved farm production method, low demand for the cocoyam, low price of cocoyam in the market, poor/lack of improved storage facilities, low soil fertility, limited range of varieties, land tenure system problem, shortage of cultivable land for production expansion, poor recognition of cocoyam as food, old age problems, non-existence of cooperatives societies in the area, ineffectiveness of the existing cooperative societies in my area and existence of some traditional beliefs that hinders effective adaptation.

Of the nineteen constraints that differ significantly, only two had a partial eta squared value of above 0.138 indicating large difference in their variance. These are low price of cocoyam in the market (0.167) and poor/lack of improved storage facilities (0.140). Thirteen have eta squared values of above 0.06 indicating a medium difference in their variation. These include lack of extension contact (0.56), lack of improved cultivars of cocoyam (0.59), lack of diseases/pest resistant cultivars (0.59), poor state of feeder roads (0.68), low demand for cocoyam (0.133), low soil fertility (0.85), shortage of cultivable land for production expansion (0.58), poor recognition of cocoyam as food (0.103), old age problems (0.70), non-existence of cooperatives societies in my area (0.71), existence of some traditional beliefs that hinders effective adaptation (0.115) and ineffectiveness of existing cooperatives (0.113). the remaining four had small eta squared value which indicates little difference in their variation (Table 5).

Table 6
Scheffe post hoc Multiple comparison test.

State		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	−8.64844*	1.89700	0.000	−13.3101	−3.9867
	3	−4.00781	1.89700	0.109	−8.6695	0.6539
2	1	8.64844*	1.89700	0.000	3.9867	13.3101
	3	4.64062	1.89700	0.051	−0.0211	9.3023
3	1	4.00781	1.89700	0.109	−0.6539	8.6695
	2	−4.64062	1.89700	0.051	−9.3023	0.0211

1-Anambra state, 2-Imo state, 3-Enugu state.
* The mean difference is significant at the 0.05 level.

Having confirmed that significant difference exists in the constraints faced by farmers in adapting to climate change in Southeast Nigeria as well as identifying the specific variables that vary. A post Hoc comparison test (Sccheffe test) was conducted to identify where exactly the difference lies. This indicated (as shown in Table 6) that the mean score for Anambra state (M = 88.0547, SD = 14.32) was significantly different from Imo state (M = 96.70, SD = 16.04). Enugu state (M = 92.06, SD = 15.12) did not differ significantly from either Anambra state or Imo state. This shows that the constraints faced by cocoyam farmers vary mainly between Anambra and Imo state and calls for specific action that will suit each state by the state government.

4. Conclusion and recommendations

The study identified eight major constraints faced by cocoyam farmers in adapting to climate change in southeast Nigeria. These eight factors include Lack/high cost of farm inputs and low soil fertility, Land and labour constraints, Poor access to information and ineffectiveness of cooperatives, lack of/poor access to fund and credit facilities and poor government support, lack of improved varieties of cocoyam, poor value attached to cocoyam, poor infrastructural capacity and technology know-how and Transportation constraint. It also identified that significant differences exist in the constraints faced by cocoyam farmers in adapting to climate change in Imo and Anambra states with low price of cocoyam in the market (0.167) and poor/lack of improved storage facilities (0.140) being the major constraints that vary. Also, the challenges faced by cocoyam farmers in adapting to climate change in the Anambra and Imo state differ significantly.

Based on the findings of the study it was recommended that there is a need to educate the farmers on the benefits of joining cooperatives thereby pooling their resources together to help in procurement of farm inputs as well as credit facilities that can enable them to adapt more effectively to climate change. Much work is still needed in the aspect of the level of value attached to cocoyam as a crop both on the side of farmers, researchers and governmental agencies. Cocoyam needs to be promoted as a valuable crop. It is only when farmers value cocoyam like their other cherished crops for instance cassava that meaningful improvement can be experienced in the overall farming system. Furthermore, specific policies and practices that could help farmers overcome challenges are needed as the study confirmed significant variation in two states studied. It is necessary for the government and other stakeholders in the area to develop and implement policies that specifically addresses the individual needs of the different states rather than general policies.

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References

Adisa, B.O., Adeokun, O.A., Oladoja, M.A., 2006. Nigerian threatened environment: an obstacle to rural poverty eradication. J. Environ. Extension 5, 51–59.
Adedoyin, S.F., Adeokun, O.A., 2004. Theory building (theoretical framework) in Agricultural Extension. In: Olowu, T.A. (Ed.), Research Methods in Agricultural Extension. Agricultural Extension society of Nigeria (AESON).
Arokoyu, S.B., Umeduji, J.U., 2004. The concept of environment. In: Bell-Gam, W.I., Arokoyu, S.B., Umeuchiji, J.E. (Eds.), Perspectives on the Human Environment. Amethyst & Colleagues Publishers, Port Harcourt.
Benhin, J.K.A., 2006. Climate Change and South African Agriculture: Impacts and Adaptation Options. University of Pretoria, South Africa. CEEPA Discussion paper No. 21. CEEPA.
Cohen, J.W., 1988. Statistical Power Analysis for the Behavioural Sciences. Lawrence Erlbaum Associates, Hillsdale, NJ.
Deressa, T., 2008. Analysis of perception and adaptation to climate change in the Nile Basin of Ethiopia (An unpublished Ph.D. thesis). Centre for Environmental Economics and Policy for Africa (CEEPA), University of Pretoria, South Africa.
Downing, T.E., Ringius, L., Hulme, M., Waughray, D., 1997. Adapting to climate change in Africa. Mitig. Adapt. Strat. Glob. Change 2, 19–44.
Enete, A.A., Amusa, T.A., 2010. Challenges of Agricultural Adaptation to Climate Change in Nigeria: a Synthesis from the Literature. Field Actions Science Reports [Online], vol. 4. http://factsreports.revues.org/678. Retrieved December 2015.
Enete, A.A., Madu, I.I., Mojekwu, J.C., Onyeukwu, A.N., Onwubuya, E.A., Eze, F., 2011. Indigenous Agricultural Adaptation to climate change: Study of Imo and Enugu State in southeast Nigeria. Africa Technology Policy studies Network working paper. Series No. 53.

Emodi, A.I., Obiora, C.J., Okere, J., 2014. Socio-economic analysis of cocoyam farmers in Ngor Okpala local government Area of Imo State Nigeria. J. Sustainable Dev. Africa 16 (2).
Eriksen, S., Lind, J., 2009. Adaptation as a political process: Adjusting to drought and conflict in Kenya's drylands. Environ. Manage. 43 (5), 817–835. http://dx.doi.org/10.1007/s00267-008-9189-0.
Eriksen, S., O'Brien, K.L., 2007. Vulnerability, poverty and the need for sustainable adaptation measures. Clim. Policy 7 (4), 337–352.
Eriksen, S., Aldunce, P., Cahinipati, C.S., Martins, R.D., Molefe, J.I., Nhemachena, C., O'brien, K., Olorunfemi, F., Park, J., Sygna, L., Ulsrud, K., 2010. When not every response to climate change is a good one: identifying principles for sustainable adaptation. Clim. Dev. 3, 7–20.
Ezemonye, M.N., Emeribe, C.N., 2012. Rainfall erosivity in Southeastern Nigeria. Ethiopian J. Environ. Studies Manage. (EJESM) 5 (2), 112–122.
FAO, 2010. Climate Change Implications for Food Security and Natural Resources Management in Africa. In: Twenty-Sixth Regional Conference for Africa, Luanda, Angola, 03-07 May 2010. Food and Agriculture Organization (FAO).
Intergovernmental Panel on Climate Change (IPCC), 2014. Climate Change 2014: Synthesis Report. Core Writing Team, Pachauri, R.K., Meyer, L.A., (Eds.), Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, 151 pp.
Mark, W.R., Mandy, E., Gary, Y., Lan, B., Saleemul, H., Rowena, V.S., 2008. Climate Change and Agriculture: Threats and Opportunities. Federal Ministry for Economic Cooperation and Development, Germany.
Mbakwe, R., Ukachukwu, S.N., Muoneke, C.O., Ekeleme, F., 2004. Problem Identification and development of research base. In: Umunna, R.P.A., Onwudike, O. C., Uwaegbute, A.C., Edeoga, H.O., Nwosu, A.C. (Eds.), Farming Systems Research and Development in Nigeria; Principles and Practice in Humid and Derived Savanna Southeast Zone. 2014.
Næss, L.O., Bang, G., Eriksen, S., Vevatne, J., 2005. Institutional adaptation to climate change: flood responses at the municipal level in Norway. Global Environ. Change 15 (2), 125–138. http://dx.doi.org/10.1016/j.gloenvcha.2004.10.003.
Nigeria Meteorological Agency (NIMET), Nigeria Climate Review Bulletin 2010. http://www.nimetng.org/uploads/publication/2010%20Climate%20Review.pdf. Retrieved 11th March 2015.
Nigeria Meteorological Agency (NIMET), 2012. 2012 Nigeria climate review. Nigerian Meteorological Agency, NIMET: Abuja.
Nzeh, E.C., Eboh, R.O., Eboh, E., Nweze N., Nzeh, C., Orebiyi, J., Lemchi, J. Climate Change Adaptation In Nigeria And Its Challenges In agricultural Sector: Empirical Information. Retrieved from http://www.academia.edu/1200946/CLIMATE_CHANGE_ADAPTATION_IN_NIGERIA_AND_ITS_CHALLENGES_IN, on November 4, 2015.
Oladipo, E., 2010. Towards enhancing the adaptive capacity of Nigeria: a review of the Country's state of preparedness for climate change adaptation. Ilorin, Nigeria.
Onwubuya, E.A., Ajani, E.N., 2012. Strategies for improving production and processing of cocoyam among farmers in Anambra state, Nigeria. Universal J. Educ. Gen. Studies 1 (6), 169–173.
Pallant, J., 2010. SPSS Survival Manual. Mc Graw Hill Education, England.
Ukonze, J.A., 2012. Impact of Climate Change on Cocoyam Production in South Eastern Nigeria. Int. J. Educ. Sci. Public Policy Africa UESPPA 2 (1), 161–168. Bloomsburg PA 17815 USA, www.globalmarkmakers.com.
Unamma, R.P.A., Onwudike, O.C., Uwaegbute, A.C., Edeoga, H.O., Nwosu, A.C., 2004. Linkage strategy for sustainable Agriculture in Nigeria. In: Research-Extension-Farmer-Input-Linkage system (REFILS). Micheal Okpara University of Agriculture, Umudike.
Wisner, B., Blaikie, P., Cannon, T., Davis, I., 2004. At Risk: Natural Hazards; People's Vulnerability and Disasters. Routledge, London.