

ADAPTATION STRATEGIES TO CLIMATE CHANGE, CHALLENGES AND THE BENEFITS DERIVED AMONG THE RURAL FARMERS IN ONDO STATE, SOUTH-WEST-NIGERIA

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Abstract

This study examined the strategies adopted by Akoko rural farmers against climate change, challenges and benefits derived. The research design for this study was cross-sectional. Multi-stage sampling technique was used to delineate the study area into strata from where four communities were systematically selected, followed by a random selection of 400 respondents. A structured questionnaire and in-depth interview guide were utilised to elicit both qualitative and quantitative data. Accordingly, twenty in-depth interviews (IDIs) were conducted. The data from the questionnaire were analysed statistically and presented in a descriptive manner, while the IDIs were analysed using content analysis. The findings revealed that farmers resorted to practices such as use of cover crops (96%), bush fallow (89.1%), prompt weeding of the farm (88.8%), changing in the timing of land preparation (86.3%), control of weed as a measure for managing the risk of damage by wild fire (77.9%). The challenges faced were: scarcity of land due to removal of plantation in climate change prone area (64.2%), and increase in number of weeding period (57.6%). The benefits derived were: reduction in incident of rotten seedlings (74.9%), increase in farm-yield (91.1%), reduction in the incident of fire outbreak on farmlands (68.2%). The study recommends that government should ensure that farmers have access to land to increase their ability and flexibility to change production strategies; and that there should be enough climate change related information from government towards guiding the farmers in their farming activities.

Keywords: climate change, adaptation strategies, agriculture, farmers, rural

Introduction

In relation to climate change, adaptation is defined by the Intergovernmental Panel on Climate Change (IPCC, 2001) as "an adjustment in natural or human system in response to actual or expected climate stimuli or the effects moderates harms or exploits beneficial opportunities". This definition shows that climate change is the driver of new conditions, and that responses or adjustments are directly related to the

impacts of climate change, including, warmer temperatures, changing precipitations patterns, sea level rise and melting glaciers. Many adaptive measures have been identified including sea wall to protect against storm surges; drought-tolerant seeds, and efficient irrigation systems to respond to water scarcity; and changes in government structures to handle inter-basin water disputes (Adger, Agrawala, Mirza, Conde and O'Brien, et al., 2007; IPCC., 2014)

Climate change has become one of the most challenging and complex problems facing humanity, and it is likely to have significant consequences on every facets of human development (IPCC, 2014; (United Nations Development Programme, UNDP, 2008). Although, measures to reduce greenhouse gas emission which has been directly linked to the change in climate can significantly influence the rate of magnitude of future climate change, most especially, as it has been projected by Scientists that temperature would increase up to the four degrees Celsius by the end of the century, (Parry, Canziani, Palutikof, Linden and Hanson, 2009).

It is increasingly recognised that society will have to adopt some measures towards adapting and alleviating the effects of climate change over the coming decades, regardless of mitigation efforts (UNDP, 2008). The complexities of climate change requires developing and implementing a sufficiently complex at all scales, from the International, to the national, to the community, and down to the household and individual levels (Girvetz, Ramirezvillegas, Claessens, Lamanna and Navarro-Racines, 2018). Efforts to adapt to the impacts of inevitable climatic changes, while at the same time drastically reducing green house gas emissions, will require transformations at a rate and scale that is unprecedented in human history and it has to be holistic in nature (Lal, Delgado, Groffman, Millar and Dell, 2011). The challenges of climate change adaptation and mitigation requires societies to adapt to not only new biophysical conditions, but also to new understandings of human environment relationships (Nyong, Adesina and Osman-Elasha, 2007).

The prediction of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) that

climate change would have a significant effect on agricultural production in many African countries is gradually becoming a reality (IPCC, 2014). Presently, there is a reduction in agricultural yield in some African countries, Nigeria inclusive, and, this is currently posing a serious threat to food security (IPCC, 2014). Over the years, farmers have been devising means towards ameliorating climate variability (Onyeneke and Madukwe, 2010). The current trend of change in climate is making agricultural activities unpredictable. The profession is also becoming unprofitable and uninteresting (Lobel, and Burke, 2008). Farmers in Africa therefore, need to employ both the indigenous and the newly introduced adaptation practices so as to cope with both current climate variability and future climate change.

Several scholars have contributed to the debate on farmers' adaptation to climate change. Smith and Skinner (2002) developed a typology for classifying and characterising agricultural adaptation options in detail, focusing on Canada. Onyeneke and Madukwe (2010), worked on farmers' crop perception of climate change and adaptation strategies taken to reduce the negative impacts of climate in the southeast rainforest zone of Nigeria. These scholars discussed farmers' adaptation to climate change, with little or no effort on the challenges faced and benefits derived by farmers as a result of the adapted strategies. It is very pertinent therefore, to identify a climate-specific element of Akoko farmers' adaptation behaviour, the challenges and benefits, in order to facilitate a societal response to climate change that is currently ravaging the agricultural sector.

This study therefore, seeks to identify the strategies adopted by Akoko farmers in Ondo State, against climate change; the challenges faced from the

37

adoption of these strategies; and, the benefits derived from the adopted strategies.

Theoretical Framework

Theory of Change for Adaptation in Agriculture

Theory of Change is the process of describing all the building blocks required to bring about a long-term goal (Weiss, 1977 cited in Msila and Setlhako 2013). It describes the process of social change by making explicit the perception of the current situation; its underlying causes, the long term change desired and the things that need adjustment for the change to happen. Clear expression of the theory of change for agricultural research and development concepts and initiatives is important because it reveals the thinking that guides the intervention and action as well as the trajectory of change within the system.

A well articulated theory of change also helps to: build a common understanding and foster collective thinking with regards to the process needed to achieve the desired change; identify potential weaknesses or gaps in our collective thinking, such as certain hypotheses or assumptions that need to be tested, refined or discarded; develop more coherent program strategies that are constructed from logically robust theories of change; and engage in a better learning that brings together theory and action. These suggest that having the theory in place creates an environment for more adaptive, iterative and non-linear approach to the way we think so that actions can be more coherent, nimble and effective. When required, evidence may be gathered to reframe the thinking and actions.

Akoko farmers' desired an increase output of agricultural produce despite the challenges posed by climate change. Years of farming, coupled with experiences gathered over these years have made the

farmers adopted some strategies and these strategies have become part and parcel of their farming activities, this they did with the intention to have an increased agricultural yields. A desire to have bountiful harvest motivated the farmers to think of what to do so as to alleviate the effect of climate change on farming. Over the years, the adaptive strategies have been found to be helpful, even though, some of the strategies come with challenges.

Methodology

This study was conducted in Akoko North East, Akoko South-West, Owo and Ose local government areas (LGAs) in Ondo North Senatorial district, Ondo State. A multistage sampling technique was adopted for the selection of 400 respondents. Four out of the six local government area were purposively selected from Ondo North Senatorial District. Akoko South West, Akoko North East, Owo, and Ose were selected because they have a sizeable number of Akoko rural farmers. This was followed by the selection of one agricultural community from each of the two LGAs in Akoko making two agricultural communities, while one farm-settlement each was also selected from Owo and Ose LGAs making two farm-settlements. Systematic sampling method was employed to divide the selected farm-communities and farm-settlements into blocks, based on the number of quarters they have. From each of the selected communities and farm-settlements, 2 blocks were randomly selected for this study and this translates to a total of 8 blocks which were selected from the existing blocks in the two farm-communities and settlements. Farmers' houses that fell within the selected eight blocks were selected systematically using Sample Interval (S.I) of 5. Finally, a total number of 394 were selected using simple

random sampling technique.

Result and Discussion

Table 1: Socio-economic Characteristics of the Respondents

Variable	Types	Frequency	Percent
Gender	Male	226	57.4
	Female	168	42.6
Age	20-29	18	4.6
	30-39	82	20.8
	40-49	184	46.7
	50-59	102	25.9
	60+	8	2.0
Religion	Christianity	233	59.1
	Islam	105	26.6
	ATR	29	7.4
	Others	27	6.9
Farming Experience	1-4yrs	42	10.7
	5-9yrs	124	31.5
	10-14yrs	140	35.5
	15yrs+	88	22.3
Marital Status	Single	24	6.1
	Marrried	330	83.8
	Divorced	19	4.8
	Separated	8	2.0
	widow/widower	13	3.3
Educational Status	no formal education	165	42.0
	primary education	140	35.5
	secondary education	77	19.5
	tertiary education	12	3.0
Monthly income	2,500-4999 naira	14	3.6
	5,000-7,499	15	3.8
	7,500-9999 naira	14	3.6
	10,000 naira and above	351	89.1
Residential area	Ose Local Government area	98	24.9
	Owo Local Government area	100	25.4
	Akoko North-East	99	25.1
	Akoko South-West,	97	24.6

The respondents' demographic characteristics shows that there were more 226 (57.4%) males, compared to females 168 (42.6%). The disparity observed in the respondents' gender was an indication that farming constitutes a male-dominated occupation. The respondents' ages ranged between 18 years and 63 years. Specifically, 18 (4.6%) of the respondents were aged between 18 and 29 years, 82 (20.8%) are aged between 30 and 39 years, 184 (46.7%) are aged between 40 and 49 years, 102 (25.9%) are aged between 50 and 59 years, and 8 (2%) are 60 years and above. This indicates that, the respondents are in their active years. About half 165(42.0%) of the total respondents had no formal education, 140 (35.5%) had completed primary education, 77(19.5%) were holder of secondary school certificate, while a minute 12(3.0%) had tertiary education, this ranges from Colleges of education, polytechnic and University. By implication, 77.5% of the respondents possess educational certificates below secondary school level. The summary of the analysis of the data collected on respondents' monthly income shows that 14 (3.6%) and 15(3.8%) of the respondents respectively earn between N 2,500 and N 4,999 and between N 5,000 and N 7,499 while 14 (3.6%) and 351 (89.1%) of the respondents respectively earn between N 2,500 and N 4,999 and naira and lastly N 7,500 and N9,999 naira each. Thus, a majority (89.1%) of the respondents earn between N 2,500 and N 4,999.

Strategies adopted by Akoko rural farm families

Table 2: Chi Square Summary on Coping Strategies Adapted to reduce the Negative effect of Climate Change

Questions	Responses	SA	A	U	D	SD	df	X ²	P
Removal of plantation in the area where future climate change may render less productive	Frequency	104	172	79	30	9	4	210.340	< .05
	%	26.4	43.7	20.1	7.6	2.3			
Control of weed as a specific measure for managing the risk of damage by wild fire	Expected	78.8	78.8	78.8	78.8	78.8	4	286.914	< .05
	Frequency	114	193	49	31	7			
Diversifying food production away from limited number of drought prone crops	%	28.9	49.0	12.4	7.9	1.8	4	102.015	< .05
	Expected	78.8	78.8	78.8	78.8	78.8			
Relocating to new fertile land outside Akoko area	Frequency	56	133	103	86	16	4	67.320	< .05
	%	14.2	33.8	26.1	21.8	4.1			
Doing more of animal farming than crop Farming	Expected	78.8	78.8	78.8	78.8	78.8	4	185.162	< .05
	Frequency	46	129	83	95	41			
Diversifying g into petty job	%	11.7	32.7	21.1	24.1	10.4	4	137.980	< .05
	Expected	78.8	78.8	78.8	78.8	78.8			
Use of resistant seedlings and animal Species	Frequency	8	31	98	160	97	4	175.365	< .05
	%	2.0	7.9	24.9	40.6	24.6			
Changing in the timing of land preparation n activities	Expected	78.8	78.8	78.8	78.8	78.8	4	427.294	< .05
	Frequency	23	38	77	153	103			
Prompt weeding	%	5.8	9.6	19.5	38.8	26.1	4	410.162	< .05
	Expected	78.8	78.8	78.8	78.8	78.8			
water storage in ponds	Frequency	46	129	152	53	14	4	189.680	< .05
	%	11.7	32.7	38.6	13.5	3.6			
Contour cropping across hill slopes	Expected	78.8	78.8	78.8	78.8	78.8	4	200.822	< .05
	Frequency	119	221	40	10	4			
Change in planting depth of seeds and Seedling	%	30.2	56.1	10.2	2.5	1.0	4	438.386	< .05
	Expected	78.8	78.8	78.8	78.8	78.8			
Use of irrigation scheme	Frequency	151	199	26	17	1	4	78.234	< .05
	%	38.3	50.5	6.6	4.3	0.3			
Bush fallow	Expected	78.8	78.8	78.8	78.8	78.8	4	456.508	< .05
	Frequency	34	61	138	148	13			
Mulching/use of cover crops	%	8.6	15.5	35.0	37.6	3.3	4	513.919	< .05
	Expected	78.8	78.8	78.8	78.8	78.8			
what other changes can you make	Frequency	43	87	182	63	19	4	13.898	< .05
	%	10.9	22.1	46.2	16.0	4.8			
At what point can you make such change	Expected	78.8	78.8	78.8	78.8	78.8	1	17.066	< .05
	Frequency	73	237	62	13	9			
	%	18.5	60.2	15.7	3.3	2.3	1	17.066	< .05
	Expected	78.8	78.8	78.8	78.8	78.8			
	Frequency	67	87	111	112	17	1	17.066	< .05
	%	17.0	22.1	28.2	28.4	4.3			
	Expected	78.8	78.8	78.8	78.8	78.8	1	17.066	< .05
	Frequency	128	223	27	13	3			
	%	32.5	56.6	6.9	3.3	0.8	1	17.066	< .05
	Expected	78.8	78.8	78.8	78.8	78.8			
	Frequency	187	191	7	6	3	1	17.066	< .05
	%	47.5	48.5	1.8	1.5	0.8			
	Expected	78.8	78.8	78.8	78.8	78.8	1	17.066	< .05
	Response	Akuro			Don't Know				
	Frequency	160			234		1	17.066	< .05
	%	40.6			59.4				
	Expected	197.0			197.0		1	17.066	< .05
	Response	During dry season			Don't Know				
	Frequency	156			238		1	17.066	< .05
	%	39.6			60.4				
	Expected	197.0			197.0		1	17.066	< .05

40

In respect of the strategies adapted by farmers Table 1 shows that, majority (70.1%) reported that they removed their plantation in the area where future climate change may render them less productive to a more arable place. This can be connected to years of flooding which has a direct link with the washing away of top soil nutrients. However, this has led to scarcity of arable land for planting in Akoko land, as well as propelled the migration of Akoko farmers out of their cultural setting to new areas where they think they can have enough land. Above seventy-seven percent (77.9%) of the respondents agreed to have been engaging in control of weed as a specific measure for managing the risk of damage by wild fire as an adaptive measure, this measure safeguards farms and plantations from being consumed by fire during dry season. This situation was aptly summed up by one of the informants:

Over the years, it is noticed that climate change has brought an increase in the outbreak of wildfire and this always consumed so many farmland, thereby destroying crops (both food and cash crops) worth millions of naira. Majority of us in this farm-settlement are native of Akoko and we usually travel home during the festive periods, most especially, during Christmas festive in December of every year and drought is always at its peak during this period. To avert fire outbreak, we do weed control, by clearing the surroundings of farmland giving it some meters away from the crops, so that whenever there is fire outbreak, by the time it gets to where there is no weed, the fire will stop" (IDI, Male, Age 31, Elegbekeka farm-settlement, March, 2015)

Forty-eight percent of the respondents (48%) concur that diversifying food production away from limited number of drought prone crops is one of the adaptive

measures being used by them, this has contributed to extinction of some local crops e.g. 'Sese' (cowpea), 'Oogodo' these are different species of beans. Some of these crops that have gone into extinction are crops which could not adapt to the changes in climate, some due to the hotness of the weather, while others had been a target to pest and insects. So, diversifying from the crops that are climate prone, and giving attention to the ones that are climate friendly would go a long way to reducing the effect(s) of climate change on Akoko farmers. Above forty percent of the respondents (44.4%) concurred to have been practicing emigration, i.e. relocating to new fertile land outside Akoko area.

Akoko is surrounded by hills and the available land for cultivation is small compared to those who are into farming profession, and this small available land has been over-used by some of these farmers also, the top layer of the soil has been washed away by frequent erosion. This has contributed to the infertility of the land and also necessitated the movement of the Akoko farmers who are willing to farm but have nowhere to farm to move out in search of arable land. Majority (70.6) disagreed to the statement that doing more of animal farming than crop farming will help solve the problem of climate change.

In the same vein, 64.9% disagreed that diversifying into petty jobs will solve the problem. About 44.4% agreed that the use of resistant seedlings would reduce the negative of climate change on farming activities. This was peculiar to those who farm on the sloppy areas and areas that are prone to erosion, The adoption of seedlings that can resist washing away of earth surface will help in reducing the effect(s) of climate change. Above eighty percent of the respondents (86.3%) concurred that changing in the timing of land preparation

41

activities as an adaptive measure has been effective.

This may not be unconnected to the fact that climate change is unpredictable, so whenever the yearly rain begins early, the farmers quickly use the opportunity to plant even when it seems it is too early. More than eighty percent of the respondents (88.8%) of the respondents agreed that prompt weeding as an adaptive measure has been helpful as this will save the crops from being overpowered by weeds, and it will also contribute to its high yield. Below average, above forty percent (46.2%) of the respondents were undecided about contour cropping across hill slopes as an adaptive measure, this may be connected to the fact that the crops that are easily grown by the farmers in Akoko North Senatorial district are not the types that can fare well on hills. Above seventy-eight percent (78.7%) agreed that change in planting depth of seeds and seedling is one of the adaptive measures use by them, this method is applied based on the climatic condition.

But more than forty percent (40.9%) disagreed that water storage in ponds is an adaptive measure. Some other agreed adaptive measures used by the Akoko farmers are; the use of irrigation scheme (39.1%), bush fallow (89.1%) and mulching or use of cover crops (96%). This is an indication that Akoko farmers have over the years been using different adaptive strategies toward reducing the effects on climate change on farming. These findings support the work of Below, Artner, Siebert, Sieber, (2010) where it was reported that African small-scale farmers adopted five categories of options to reduce the effects of climate change. These adaptation practices range from crop switching to introducing a mix of livestock and cropping at farm level to inaugurating anti-erosion measures and multiple practices for managing drought at

the local level. It is also in line with the report of Maddison, (2007) that many adaptations to climate change involves the use of resistant varieties such as early maturing varieties or drought resistant ones.

Challenges associated with adopted Strategies

On the challenges associated with adaptive measures on the effect of climate change, the findings revealed that a little above average (59.9%) of the respondents concurred that diversification away from drought prone crops has sent many easily grown crops into extinction. Majority (75.6%) of the respondents negate the statement that movement out of cultural setting in search of land has cut-off farmers from their place of origin and people. 78.7% concurred that irrigation farming takes a lot of time which ordinarily would have been devoted to other farming activities.

Two-third of the respondents (64.2%) concurred that the removal of plantation in the area where future climate change might make them less productive has led to the scarcity of land for farming and this is one of the factors necessitating the movement of Akoko farmers to Ose and Owo local government areas. On a different view, two-third (65.2%) negate the saying that the use of organic manure usually shortens the storage life span of farm products. Lastly, majority of the respondents concur that prompt weeding has increased the number of weeding period unnecessarily hereby making farming profession tedious.

These are the challenges that make farming under climatic changes difficult as attested to by farmers.

Benefits derivable from the adopted Strategies

Findings from Table 3 indicated the benefits in using the possible coping

42

strategies by farmers, 45.5% agreed that irrigation has extended the period of farming hereby making fresh agricultural good available throughout the year. In same vein, 74.9% agreed that changing in the planting depth of seedling has reduced the incident of rotten seedling. On a contrary view, more than fifty percent of the respondents (55.3%) disagreed on the statement that diversification into petty job had engaged many farmers who could have been jobless due to negative effect of climate change the reason for this is that culturally, Akoko communities are known to be a typical agrarian communities, and for a young man of working-age to engage in petty-job, such may be tagged to be lazy. Also 64.2% disagreed on the statement that money realize from fish or poultry farming is more than money realize from agricultural farming. Other benefit reported were the production of dry season goods, fertilizer at

subsidize rate and security of farmlands

Faced with unpredictable climatic variables, Akoko farmers in Ondo North senatorial district claimed to have been adopting multiple options of strategies, which were used in combination at the same time. Much of this response is reactive, in the sense that it is triggered by past or current events (e.g., drought occurrences) but it is also anticipatory in the sense that it is based on some assessment of conditions in the future (e.g., rainfall occurrences). Adaptations may already be practiced before droughts while others are activated as drought evolves. Such adaptive changes at household farming level have been argued by Darnhofer, Bellon, Dedieu, Milestad, (2010) as mostly undertaken due to uncertainties faced by farmers. To cope with areas that are prone to flooding and areas that have been over-stressed with frequent planting of crops,

Table 3: Chi Square Summary on Statement regarding Benefits Derived from the Strategies Adopted.

Questions	Responses	SA	A	U	D	SD	Df	X ²	P	
Irrigation has extended the period of farming, thereby making fresh agricultural goods available throughout the year	Frequency	81	98	136	70	9	4	109.071	< .05	
	%	20.6	24.9	34.5	17.8	2.3				
	Expected	78.8	78.8	78.8	78.8	78.8				
Changing in the planting depth of seed and seedling has reduce the incident of rotten seeds and seedling	Frequency	85	210	79	17	3	4	340.315	< .05	
	%	21.6	53.3	20.1	4.3	0.8				
	Expected	78.8	78.8	78.8	78.8	78.8				
Diversification into petty job has engaged many farmers who could have been jobless due to negative effect of climate change	Frequency	52	53	71	145	73	4	74.376	< .05	
	%	13.2	13.5	18.0	36.8	18.5				
	Expected	78.8	78.8	78.8	78.8	78.8				
Money realize from fish/poultry farming is more than money realize from agricultural farming	Frequency	16	38	87	136	117	4	132.066	< .05	
	%	4.1	9.6	22.1	34.5	29.7				
	Expected	78.8	78.8	78.8	78.8	78.8				
Could you please suggest other benefits derivable	Response	Dry season goods				Don't Know		1	32.985	< .05
	Frequency	140				254				
	%	35.5				64.5				
	Expected	197.0				197.0				

43

farmers adopt a method of removing plantation in the area where future climate change may render less productive. Discussants knew which crop varieties they cultivate based on effect of climate change on some of these crops. Some species of crops like cow-pea 'sese' and 'orogodo' have long disappeared. This was due to years of cultivation with little or nothing to show for the efforts put into planting. Once it is noticed that a particular specie of crop is not yielding as expected, the Akoko farmers concurred to have diversified food production away from limited number of drought prone crops. Diversification has been identified as a potential farm-level adaptation to climatic variability. Studies done by Gajanana and Sharma (1990) in Tumkur district, Karnataka, India, quoted in Speranza, found that many crops were cultivated simultaneously by farmers in Karnataka. However, discussants point the diversification of crops as a method to ensure some harvests

Conclusion

Despite the challenges faced by the farmers due to the adoption of the indigenous measures, they attested to the fact that they derived the following benefits; increase yield of farm produce as a result of application of fertilizer; availability of fresh agricultural products throughout the year, this was made possible through 'Akuro' farming,; and finally, ability to have saved many farmland from being consumed by fire as a result of formation of rotational watch group. The farmers agreed that it is not easy for a big-time farmer to leave farming profession for poultry farming or any petty-job. These finding negate the work of Ajetomobi, Ajiboye and Hassanc, (2011) where about 65% and 57% of the irrigated rice farmers and dry-land rice farmers in Nigeria respectively engaged in various off-

farm works, which include, artisan, teaching and other vocational activities.

Recommendations

Based on the findings obtained from the farmers in the study area, the following recommendations were made: (i) government should supply adequate information to farmers in climate risk management; (ii) government should brace up to the new challenges posed by climate change by mounting awareness programmes, and disseminating proven measures to boost the adaptive capacities of various farmers, to climate change in the study area. These will of course reduce the effects/impacts of climate change.

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