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INDIGENOUS TECHNOLOGIES USED BY FARMERS FOR COMBATING CLIMATE CHANGE HAZARD IN CROP PRODUCTION IN UMUAHIA AGRICULTURAL ZONE OF ABIA STATE

By

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Abstract
The study was carried out to examine indigenous technologies used by farmers for combating climate change hazard in crop production in Umuahia Agricultural Zone of Abia State. The study was guided by three research questions and three null hypotheses. The study adopted survey research design. The population of the study was 451 comprising 403 farmers and 48 extension agents. The sample of the study was 152 comprising 120 farmers and 32 extension agents selected using simple random sampling technique. The instrument for data collection was structured questionnaire validated by three experts. Data collected was analysed using mean and standard deviation and t-test statistic to test the hypotheses at 0.05 level of significance. The results of the findings indicated that: causes of climate change include: Indiscriminate bush burning, deforestation, fossil fuel burning, gas flaring and illegal bunkering. It was revealed that the hazards posed by climate change in crop production were: Increase in temperature reduce crop yields drastically, and poor agricultural production among others. In addition, it was revealed that the indigenous technologies used by farmers in crop production were: Mulching of crop, early planting of crops, use of compost and green manure. From the findings, it was recommended that: Federal Government of Nigeria in collaboration with Abia State Government should ensure adequate awareness campaign on the causes of climate change and climate change hazard to enable the farmers and other individual t refrain from practices like deforestation and illegal bunkering that contributed to climate change.

Keywords: Indigenous Technologies, Farmers, Climate Change Hazard and Crop Production

Introduction

Agriculture is the main stain of any nation's economy. It is source of human survival since the ages past as it accounts for employment of Nigerians (graduates and non-graduates), a source of foreign exchange, provides food to man and raw materials for local industries (Iwena, 2015). Agriculture is a sector inherited from generations to generations as well as a dominant occupation which engages many populations in Nigeria as a way of life of many rural dwellers for production of crops and animals for human use and supply to agro-allied industries needed by other sectors of the economy. This implies that agriculture remains the bedrock and corner stone of the economy of many nations especially the economies of the developing nations like Nigeria (Oksana et al., 2019).

However, the two major aspect of agriculture (crop and animal production) engaged by farmers in the rural areas dependent on one another both positively and negatively. Thus, crops provide feeds to man and animals, animals supply animal protein and nutrients to man and excreta as manure for crop production in symbiotic relationship. On the other hand, animals can destroy both the crop and environment (land, water, air) if not effectively controlled (Nwokoro & Chima, 2017). Consequently, farmers and the environment relate to each other in a mutual manner, because as their farming activities affect the environment, it in turn affects the farmers and their plants. The effect of one on the other could be positive or negative (Oruonye & Okrikata, 2015). Therefore, protection of the environment through appropriate agricultural practices is necessary to avert the impact of climate change cause mostly by human activities.

Climate change is the worldwide environmental threats that seriously affect agricultural productivity and mankind in numerous ways, including its direct influence on food production (Ozor, 2019). Climate is the average weather condition of an area taken over a prolonged period of time (American Meteorological Society, AMS, 2017). It is the statistics of temperature, humidity, pressure, wind, rainfall, sunshine intensity and other meteorological elemental

measurements in a given area over a long period of time, usually 30years and above (Intergovernmental Panel on Climate Change, IPCC, 2017).

According to Onu and Ikehi (2017), the causes of climate change can be linked basically to factors such as: industrial revolution, for instance the activities of automobiles and other industries have led to emission of several gases like carbon dioxide into the atmosphere which over time affects the composition of greenhouse gases leading to altered climate; Burning of fossil fuels by oil producing companies and refineries which emit greenhouse gases into the atmosphere; land use change such as deforestation and desertification which leads to climate change, and agricultural activities such as bush burning, fertilizer application, fermentation among others, all of which are anthropological influencers of climate change.

The climate change causes a lot of hazard in agricultural production especially in the aspect of crop production. Agricultural crops are vulnerable to climate change, higher temperatures reduce the yields of desirable's crop, encouraging weeds and pests proliferation, changes in patterns of precipitation increase crop failures and long-run production declines. The most devastating hazard of climate change includes environmental damage through flooding which wash away crop produce, pests and diseases infestation of crops, drought and biodiversity loss (Adebisi et al., 2020). These pose serious threat to the farmers on the sustainability of crop production.

Farmers as described by Olukosi and Ogungbile (2015) are individuals who engage in agriculture, raising crops and livestock for food and raw materials for industries. On the other hand, Erebor in Chidiadi (2019) defined farmers as men and women who own farms and manage farming operations such as rearing of pigs, goats, poultry and growing of crops such as cassava, yam, cocoyam and tomatoes among others. These farmers faced various challenges which include that of climate change affecting farming activities on the yearly basis. Therefore,

to combat the climate change challenges faced by farmers the adoption of indigenous technologies became imperative so as to enhance food production.

Technology refers to the use of scientific knowledge to invent tools that assist human beings in their efforts to overcome environmental hazards and impediments to comfort. It is also the theoretical and practical knowledge, skills, and artifacts that can be used to develop products and services as well as their production and delivery systems (Alonge & Olatoye, 2020). On the other hand, indigenous technology is described as the wisdom, techniques, approaches, skills and practices adopted by the farmers through the accumulation of experiences and informal experiments. It is also non-conventional body of knowledge that deals with some aspects of the practices adopted by the farmers without direct inputs from the modern, formal and scientific knowledge towards the management of farms (IPCC, 2022).

However, the use of indigenous knowledge and technologies in ameliorating the hazard pose by climate change is important as means for enhancing agricultural production. According to Ihenacho et al. (2019) such indigenous technologies in crop production may include: mulching using dry or fresh leaves, the use of organic manure to boost soil fertility, zero-tillage, construction of wells and basin for water storage among others. More so, Ihenacho et al. (2019) also maintained that the challenges pose by climate factors in crop production can also be manage or curtail with the adoption divers' indigenous technologies by the farmers.

Consequently, in view of Igberi et al. (2022), the use of indigenous technologies in combating climate hazard by farmers are delimited by different constraints which is not limited to adequate knowledge of the farmers on indigenous technologies, undermine of indigenous technologies by some farmers, and lack of farmers education by extension agents among others. All these factors seem to militate against adequate use of indigenous technologies by the farmers. Above all, it is on this background the study sought to examine the indigenous technologies used by

farmers for combating climate change hazard in crop production in Umuahia Agricultural Zone of Abia State.

Statement of the Problem

Agriculture is one of the most climate-sensitive enterprises, with outdoor production processes that depend on particular levels of temperature and precipitation controlled by weather conditions. Climate has changed with recent ecological happenings, such as rising temperature and flood becoming more frequent.

Unfortunately, the agricultural sector (crop) is at the receiving end of this climate change. In Abia State, there is increased occasion of flood, rise in average temperature and variation in rainfall pattern, resulting from climate change. Thus. crop cultivation have been affected consequently destabilizing farming activities and crop yield as also reported by Onyenweaku (2019) that climate change had very high negative influence on crop. The situation has become very worrisome as many farmers seem not to adequately utilize the indigenous technologies at their disposal to ameliorate the hazard pose by climate factors. Many farmers seem not to consider the local technologies as alternative measures due to technical know-how and adequate knowledge and information on the application of such technologies.

Nevertheless, it is also worrisome that adequate support has not been given to the farmers by the extension agents on divers indigenous technologies for enhancing agricultural production as such this contributed to the losses recount by the farmers due to climate change hazard. Therefore, it is on this juncture it becomes imperative to undertake this study in order to examine the indigenous technologies used by farmers for combating climate change hazard in crop production in Umuahia Agricultural Zone of Abia State.

Purpose of the Study

The general purpose of the study is to examine the indigenous technologies used by farmers for combating climate change hazard in crop production in Umuahia Aggricultural Zone of Abia State. Specifically, the study sought to:

1. examine the hazard pose by climate change in crop production,
2. determine the indigenous technologies that can be used to combat climate change hazard by farmers in crop production,

Research Questions

The following research questions were posed guide the study:

1. What is the hazard pose by climate change in crop production?
2. What are the indigenous technologies that can be used to combat climate change hazard by farmers in crop production?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

$H0_1$: There is no significant difference between the mean ratings of farmers and extension agents on the hazard pose by climate change in crop production;

$H0_2$: There is no significant difference between the mean ratings of farmers and extension agents on the indigenous technologies that can be used to combat climate change hazard by farmers in crop production.

Methodology

The study adopted survey research design. Descriptive survey research design in the submission of Nworgu in Kabiru and Aminu (2017) is one in which a group of people or items is studied by collecting data through interview or questionnaire and analysing them. The design was suitable for this study because this study made use of questionnaire to get the opinions of the respondents using questionnaire to ascertain the views, ideas and opinion. The study was

conducted in Umuahia Agricultural Zone of Abia State. The population of the study was 451 comprising 403 farmers and 48 extension agents in Umuahia Agricultural Zone of Abia State (Abia State Agricultural Development Programme, 2023). The sample of the study was 152 comprising 120 farmers and 32 extension agents. The sample size was derived using sampling formula of (Kregcee & Morgan, 1970) and simple random sampling technique was used to select the sample. The instrument for data collection was structured questionnaire developed by the researcher titled: "Indigenous Technologies Used by Farmers for Combating Climate Change Hazard Questionnaire (ITUFCCCHQ)''. The instrument was validated by three experts. The instrument drafted was presented to two experts in Agricultural Education Department and one expert in Measurement and Evaluation unit of the Department of Science Education, College of Education, Michael Okpara University of Agriculture, Umudike. Cronbach Alpha Statistic was used to compute the reliability which yielded the coefficient of 0.78, 0.75 and 0.76 for the three clusters and overall reliability coefficient index value of 0.76 considered reliable for the study. Data collected was analysed using mean and standard deviation to answer the research questions and t-test statistic was used to test the hypotheses at 0.05 level of significance. The cut-off point for the mean was 2.50 and above accepted as agreed while those below was considered as disagreed. The hypotheses of no significant difference were upheld for items whose t-calculated value are less then t-table value and rejected on the otherwise.

Results

Research Question 1: What are the hazard pose by climate change in crop production?

The data that answers research question 1 is presented on table 1

Table 1: Mean and Standard Deviation of the Respondents' Responses on the Hazard Pose by Climate Change in Crop Production

n=210

S/N	ITEM STATEMENTS	$\bar{X}$	S.D	Rmks
1.	Increases in temperature reduce crop yields drastically	3.45	0.56	Agreed
2.	Reduction in crop yields	3.12	0.71	Agreed
3.	Reduction in seed germination due high temperature	3.19	0.74	Agreed
4.	Stunted growth of crops	3.20	0.64	Agreed
5.	Crop disease infestation	3.35	0.67	Agreed
6.	Ineffectiveness of agricultural chemicals due to delay of rainfall affect crop yield	3.22	0.65	Agreed
7.	Poor agricultural production	3.44	0.71	Agreed
	Cluster Mean	**3.28**	**0.67**	Agreed

KEYS: $\bar{X}$ = mean, S.D= Standard deviation, Rmks. = Remarks.

From the data in table 1 above, the mean responses of the respondents ranges from 3.12 - 3.45 which are all above the cut-off point of 2.50. This implies that the 7 items are the hazard pose by climate change in crop production. Also, the standard deviation of all the items ranges from 0.56 – 0.74 which shows that the responses of the respondents are close to one another in their responses and that they were not far from the mean.

Hypothesis 2: There is no significant difference between the mean ratings of farmers and extension agents on the hazard pose by climate change in crop production.

Table 2: t-test analysis of Mean Ratings of Farmers and Extension Agents on the Hazard Pose by Climate Change in Crop Production

S/N	ITEM STATEMENT	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	t-cal.	Rmks
1.	Increases in temperature reduce crop yields drastically	3.46	0.55	3.45	0.56	0.09	NS
2.	Reduction in crop yields	3.13	0.61	3.11	0.81	0.13	NS
3.	Reduction in seed germination due high temperature	3.21	0.71	3.17	0.76	0.27	NS
4.	Stunted growth of crops	3.21	0.67	3.19	0.61	0.16	NS
5.	Crop disease infestation	3.36	0.69	3.33	0.65	0.23	NS

6.	Ineffectiveness of agricultural chemicals due to delay of rainfall affect crop yield	3.23	0.64	3.21	0.66	0.15	NS
7.	Poor agricultural production	3.45	0.69	3.42	0.73	0.21	NS

Keys: $\bar{X}_1$ = Mean of farmers, $\bar{X}_2$ = Mean of extension agents, SD_1 = Standard deviation of farmers, SD_2 = standard deviation of extension agent, **N**=Number of respondents, **S*** =Significant, **NS** = Not Significant**,** Degree of Freedom = $n_1+n_2-2= 120+32-2= 150$.

Data presented in Table 2 revealed that the 7 items in the table had their t-calculated (t-cal.) values ranged from 0.09 to 0.26 which are less than t-table (t-tab) value of 1.97 at $p \leq 0.05$ level of significance and at 150 degree of freedom (df). This finding revealed that there is no significant difference between the mean ratings of farmers and extension agents on the hazard pose by climate change in crop production on the 7 items. Therefore, the null hypothesis accepted.

Research Question 2: What are the indigenous technologies that can be used to combat climate change hazard by farmers in crop production?

The data that answers research question 2 is presented on table 3

Table 3: Mean and Standard Deviation of the Respondents' Responses on the Indigenous Technologies that can be Used to Combat Climate Change Hazard by Farmers in Crop Production

n=210

S/N	ITEM STATEMENTS	$\bar{X}$	S.D	Rmks
1.	Mulching of crop	3.35	0.66	Agreed
2.	Use of early planting of crops	3.48	0.59	Agreed
3.	Adoption of compost manure in early planting	3.50	0.58	Agreed
4.	Use green manure	3.42	0.66	Agreed
5.	Planting of trees in the farms	3.45	0.71	Agreed
6.	Crop rotation	3.49	0.62	Agreed
7.	Mix farming techniques	3.23	0.72	Agreed
	Cluster Mean	**3.42**	**0.65**	Agreed

KEYS: $\bar{X}$ = mean, S.D= Standard deviation, Rmks. = Remarks.

From the table 3 above, the mean responses of the respondents ranges from 3.23-3.50 which are all above the cut-off point of 2.50. This implies that the 7 items are the indigenous

technologies that can be used to combat climate change hazard by farmers in crop production. Also, the standard deviation of all the items ranges from 0.58-0.72 which shows that the responses of the respondents are close to one another in their responses and that they were not far from the mean.

Hypothesis 2: There is no significant difference between the mean ratings of farmers and extension agents on the indigenous technologies that can be used to combat climate change hazard by farmers in crop production.

Table 4: t-test Analysis of Mean Ratings of Farmers and Extension Agents on the Indigenous Technologies that can be Used to Combat Climate Change Hazard by Farmers in Crop Production

S/N	ITEM STATEMENT	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	t-cal.	Rmks
1.	Mulching of crop	3.35	0.65	3.34	0.67	0.07	NS
2.	Use of early planting of crops	3.49	0.61	3.47	0.57	0.18	NS
3.	Adoption of compost manure in early planting	3.50	0.58	3.49	0.57	0.09	NS
4.	Use green manure	3.43	0.67	3.41	0.65	0.15	NS
5.	Planting of trees in the farms	3.45	0.69	3.44	0.72	0.07	NS
6.	Crop rotation	3.51	0.63	3.46	0.61	0.42	NS
7.	Mix farming techniques	3.25	0.71	3.21	0.73	0.28	NS

Keys: $\bar{X}_1$ = Mean of farmers, $\bar{X}_2$ = Mean of extension agents, SD_1 = Standard deviation of farmers, SD_2 = standard deviation of extension agent, **N**=Number of respondents, **S*** =Significant, **NS** = Not Significant**,** Degree of Freedom = $n_1+n_2-2= 120+32-2= 150$

Data presented in Table 4 revealed that the 7 items in the table had their t-calculated (t-cal.) values ranged from 0.07 to 0.40 which are less than t-table (t-tab) value of 1.97 at $p \leq 0.05$ level of significance and at 150 degree of freedom (df). This finding revealed that there is no significant difference between the mean ratings of farmers and extension agents on the indigenous technologies that can be used to combat climate change hazard by farmers in crop production the 7 items. Therefore, the null hypothesis was accepted.

Discussions of the Findings

The findings were discussed in accordance with the research questions and hypotheses that guided the study as follows:

From the results of the study in research question one, it was revealed that the hazard posed by climate change in crop production were: Increase in temperature reduce crop yields drastically, reduction in crop yields, reduction in seed germination due high temperature, stunted growth of crops, crop disease infestation, ineffectiveness of agricultural chemicals due to delay of rainfall affect crop yield and poor agricultural production. Similarly, the result of the hypothesis tested indicated that there is no significant difference between the mean ratings of farmers and extension agents on the hazard pose by climate change in crop production. The findings align with the study of Onyenweaku (2019) that climate change had very high negative influence on crop production. The findings also correspond with Rudolf and Hermann (2019) in the study of farmer's perception of impact of climate change on food crop production which revealed low yield of crop, stunted growth of crop, ease spread of pest and disease attack on crops, drying of seedling after germination and ineffectiveness of agricultural chemicals due to delay of rainfall.

From the findings of the study on research question two, it was revealed that the indigenous technologies that can be used to combat climate change hazard by farmers in crop production were**:** Mulching of crop, use of early planting of crops, adoption of compost manure in early planting, use green manure, planting of trees in the farms, crop rotation, mix farming techniques. Meanwhile, the hypothesis tested indicated that there is no significant difference between the mean ratings of farmers and extension agents on the indigenous technologies used in combating climate change hazard by farmers in crop production. The findings also align with the study of Adeniran et al. (2017) that indicated the use of cover cropping and afforestation as solution to combat climate change. The authors added that cover crops aid soil improvement of

soil tilt and remediation of compaction; protection of soil from wind and water erosion addition or recycling of plant nutrients; increase in biological activity of soil, retention of soil moisture and in some cases suppression of weeds, insects, pathogens and nematodes.

Conclusion

From the findings of the study, it was concluded that climate change posed serious threat to crops. This has become a very serious issues to the farmers and the larger society as it has contributed to low food production and by extension food insecurity. Consequently, it was revealed that the causes of climate change include: Human activities such as indiscriminate bush burning, indiscriminate deforestation, fossil fuel burning, gas flaring, population explosion, ozone layer depletion, carbon emission and illegal bunkering. Therefore, to enhance crop production all farmers should adopt indigenous technologies such as mulching of crops, early planting, crop rotation and use of green manure to combat climate change hazards.

Recommendations

From the findings and conclusion of the study, it was recommended that:

1. The Federal and Abia State Government should ensure adequate awareness campaign on climate change and also the hazards to discourage practices such as deforestation and illegal bunkering among others that contributed to climate change which posed serious hazard to food security.
2. The identified indigenous technologies should be used by farmers in Abia State as part of measures for combating climate change hazard by farmers in crop production.

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