

**ADAPTATION STRATEGIES TO EFFECTS OF CLIMATE CHANGE ON
VEGETABLE PRODUCTION AMONG WOMEN FARMERS IN IMO STATE,
NIGERIA**

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ABSTRACT

This study examined the adaptation strategies the women vegetable producers in Imo State, Nigeria, used in reducing the effects of climate change on their production of vegetables. Using an interview schedule and multistage sampling, ninety (90) women vegetable producers were chosen selected for this study. Descriptive statistics and multiple regression analysis were employed for the analysis. Result revealed that vegetable women farmers were aware of change in climate (98.88%) and mainly obtained information from extension agents (94.4%). The major effects that were perceived of climate change by women producing vegetables were low quality of vegetables ($\bar{x} = 3.17$), loss of revenue ($\bar{x} = 3.09$), delay in maturation of vegetables ($\bar{x} = 3.02$), increased postharvest loss ($\bar{x} = 3.00$), flooding of farmland ($\bar{x} = 2.92$), loss of suitable land for agriculture ($\bar{x} = 2.89$) and famine ($\bar{x} = 2.82$). The major adaptation strategies used were elevation of the farm walls with sandbags or blocks to channel floodwater ($\bar{x} = 3.30$), changing the planting/stocking time ($\bar{x} = 3.13$), using improved crop varieties ($\bar{x} = 3.10$), avoidance of scorching by planting vegetables deeper than the usual planting depth ($\bar{x} = 2.98$), practicing mix cropping ($\bar{x} = 2.96$), using nursery for transplantable crops ($\bar{x} = 2.77$), use of mulching materials for crops ($\bar{x} = 2.70$), change of harvesting date ($\bar{x} = 2.70$), using early maturity plants ($\bar{x} = 2.70$). However, the farmers identified constraints in the usage of adaptation strategies in vegetable production as limited access to agricultural extension officers ($\bar{x} = 3.65$), inadequate access to timely information on weather ($\bar{x} = 3.50$), inadequate credit facilities ($\bar{x} = 3.24$), inadequate farm labour ($\bar{x} = 3.21$), limited farm sizes ($\bar{x} = 2.92$), unpredictable weather ($\bar{x} = 2.91$) and insufficient access to water resources ($\bar{x} = 2.67$). Therefore, the study concludes that climate change threatened vegetable production and the study recommends that women vegetable farmers should have more contact with extension agents to give them access to appropriate adaptation strategies that can minimize the effects of climate change on vegetable production. Also, vegetable producers should practice effectively adaptation strategies to prevent flooding that can cause a reduction in available land for vegetable production.

Keywords: Adaptation Strategies, Climate Change, Vegetable Production

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INTRODUCTION

Nigeria's agriculture is a significant industry since it employs more than 60% of its workforce. A more substantial percentage of women in rural Nigerian communities are engaged in agriculture as a livelihood. Food and vegetable crops are the popular crop mix among women farmers in Nigeria. In most low-income nations, women produce 60-80% of the food, making them significant contributors to the food chain. Women often produced fluted pumpkins and other vegetables and crops to meet household expenses. Vegetables are portions of the plant eaten as food and by people and other animals. In addition, vegetables are all edible plant materials, including seeds, fruits, flowers, roots and leaves (Effiong & Ekanem, 2019). Vegetables form a vital part of human nutrition, which are mainly low in carbohydrates and fat but also rich in minerals, dietary fiber and vitamins; and these can be eaten either cooked or fresh (Ibeawuchi et al., 2015; Egwuonwu, 2020). Women are essential contributors to the agriculture industry. Still, in comparison to men, women own fewer assets, have less access to finance, inputs, land and extension services; and yet women are more vulnerable to adverse effects of accelerating climate change (World Bank, 2015). Climate change affects production of crops, especially vegetable production.

African continent is noted by Inter-Governmental Panel on Climate Change (IPCC), 2014; and Niang, et al. (2014) to be a central region of the globe that is mostly vulnerable to the climate change effects. Climate change pertains to the gradual alterations in several climate parameters over an extended duration, such as precipitation, temperature, and wind patterns. According to Mattos et al. (2014), vegetables can be more affected in yield and quality by a slight rise in average daylight and nighttime temperatures. Additional research has also demonstrated that elevated temperatures impact the flavor, hardness, and physical and physiological conditions of vegetables and fruits as they grow (Spaldon et al., 2015; Deuter, 2014). It is also possible that extreme water stress circumstances impact vegetable productivity. Ultimately, this impacts vegetable women farmers' income and agricultural yield. Furthermore, the severity of these environmental conditions in sustaining and improving vegetable yield is influenced by climate change.

Women producing vegetables may see climate change as threatening their vegetable production. Climate change may worsen food security and increase hunger for vegetable producers in Imo State, Nigeria. It is essential to understand how female vegetable farmers view climate change's impact and how they will address some climate change effects connected with vegetable production, such as low yield, pest and disease incidence, and heat and cold stress. Also, it is necessary for vegetable producers to use adequate adaptation strategies to withstand the extreme consequences of the climate change. This study ascertained awareness of climate change on production of vegetables; ascertained source of information on climate change; ascertained the climate change effects on vegetable production; identified the adaptation strategies that women used to reduce climate change effects on vegetable production and also identified the constraints to the use of adaptation strategies.

METHODOLOGY

The study was carried out in Imo State, Nigeria. It occupies a total land area of 5,077.26 km² and a population of 3,929,503. It has 27 Local Government Areas (LGAs) with 3 Agricultural Zones namely Okigwe, Orlu and Owerri. The state is located between longitudes 6°35' and 7°28' east of the Greenwich meridian and latitude 5°45' and 6°35' north of the equator (National Bureau of Statistics, 2020). All the vegetable farmers in the Imo State served as the study population. Multistage sampling was employed to choose the female vegetable farmers. One LGA was purposely selected from each of the three agricultural zones in Imo State due to the large concentration of vegetables in the production. From each of the selected LGAs, two communities were chosen at random. Finally, a sample of ninety (90) female vegetable farmers was obtained by randomly selecting fifteen farmers from each community. A structured questionnaire was utilized to get the primary data. Descriptive statistics (frequency distribution, percentage and mean) were used to realize the objectives. Specifically, 4 point Likert type scale of strongly agree (4), agree (3), disagree (2), and strongly disagree (1) was used to determine women farmers' perceived effects of climate change on vegetable production and women farmers' adaptation strategies to climate change on vegetable production. The addition of these values gave up the mid-point of 2.50, which implies that scores of 2.50 and above indicate that female vegetable farmers perceived rightly the effects of climate change on vegetable production.

RESULTS AND DISCUSSION

Farmer's Awareness of Climate Change

Table 1 displays the results on awareness of climate change among women vegetable farmers. It shows that all the female vegetable farmers (100.00%) were aware of severe flooding, almost all (98.88%) were aware of climate change, extreme rainfall (96.67%), they experienced longer dry seasons (94.44%), delayed onset of rains (88.88%) and drying up of streams or rivers (80.00%). This shows that women vegetable farmers were well aware of climate change. The study supports the conclusions of Williams et al. (2018), who concluded that extreme flooding and unpredictable rainfall are becoming more common due to climate change.

Sources of Information

Result of women vegetable farmers based on the sources of information on climate change is presented on Table 2. It reveals that the majority of women farmers (94.4%) sourced information from extension agents, farmers associations (86.7%), friends and relatives (50.0%), radio (76.7%), bulletin/posters (31.1%), GSM phone (58.9%) while (74.4%) was sourced from fellow farmers. This implies that women in vegetable production always have access to information from many sources, but their major sources were extension agents, farmers' associations, and radio. The finding aligns with Esan et al. (2018) that farmer usually source information on

climate change through radio and friends. Farmers sourcing for climate change information will help them make better decisions and use appropriate adaptation strategies.

Perceived Effects of Climate Change on the Production of Vegetable

The result in Table 3 shows the effects of climate change on vegetable production among women farmers in the study area. Low quality of vegetables ($\bar{x} = 3.17$) was perceived as the major effect of climate change. Vegetables are always sensitive to extreme temperatures, which can cause a reduction in the quality of vegetables. The finding is supported by the findings of Abewoy (2018), which state that climate change affects the quality and quantity of vegetable production. The women vegetable farmers also experienced loss of revenue ($\bar{x} = 3.09$) due to changes in the climate. As climate change is affecting the production of vegetables, there is a reduction in both the quantity and the quality of vegetables produced, causing a decrease in farmers' revenue. Mattos et al. (2014) found that even a slight rise in the average day or night temperature might significantly impact the yield and quality of vegetables. The result also revealed that women vegetable farmers agreed that climate change leads to increased postharvest loss ($\bar{x} = 3.00$) and delay in the maturation of vegetables ($\bar{x} = 3.02$). Flooding of farmland ($\bar{x} = 2.92$), increased hunger and malnutrition ($\bar{x} = 2.89$), scorching of seedlings ($\bar{x} = 2.89$), climate change caused famine ($\bar{x} = 2.82$), reduced length of growing season ($\bar{x} = 2.72$), poverty ($\bar{x} = 2.62$) and failure of the crop ($\bar{x} = 2.53$) were the perceived effects of climate change.

The findings' aggregate mean ($\bar{x} = 2.76$) indicates that the women vegetable farmers agreed that climate change is significantly affecting their production of vegetables in the area. These findings share views with Komba & Muchapondwa (2012), who found that rising temperatures directly threaten small-holder farmers' production systems. This is because they can cause heat stress in plants, reduce water availability, reduce their overall output, and bring in new pests and illnesses. According to Ani et al. (2021), climate change leads to low income, poor living circumstances, and declining crop output. Variations in the climate will instantly result in a reduction in the yield of vegetables produced and income. Additionally, this research supports Spaldon et al. (2015) that a high temperature affects vegetables' flavor, hardness, and physical characteristics.

Adaptation Strategies to Effects of Climate Change on Production of Vegetable

The adaptation strategies that women vegetable farmers adopted to lessen the effect of climate change on the production of vegetables in the study area are shown in Table 4. The women elevated the farm walls with sandbags or blocks to channel floodwater ($\bar{x} = 3.30$); this was done to prevent flooding into their vegetable farms. IPCC (2007) noted that farmers use sandbags to control flooding due to heavy rainfall. The women vegetable farmers also practiced changing the planting/stocking time ($\bar{x} = 3.13$); farmers used improved crop varieties ($\bar{x} = 3.10$). Deuter (2014) observed that farmers can reduce the effects of climate change on their vegetable production by planting improved varieties that can resist harsh conditions.

Women vegetable farmers further adopted avoidance of scorching by planting vegetables deeper than the usual planting depth ($\bar{x} = 2.98$), practicing mix cropping ($\bar{x} = 2.96$), using nursery for transplantable crops ($\bar{x} = 2.77$), use of mulching materials for crops ($\bar{x} = 2.70$), change of harvesting date ($\bar{x} = 2.70$), using early maturity plants ($\bar{x} = 2.70$). This is in line with the findings of Abewoy (2018) that vegetable farmers do alleviate the effects of climate change in their vegetable production by planting seeds that can germinate on time, mature earlier before time, using nursery to nurture some young seedlings and harvest vegetables on time. Further, the result in Table 4 shows that vegetable farmers were using intensive fertilizer and or manure application for crop production ($\bar{x} = 2.62$), practicing shifting cultivation/crop rotation ($\bar{x} = 2.61$), changing from the production of agriculture to marketing ($\bar{x} = 2.60$), expansion of farmland ($\bar{x} = 2.57$), skipping storage but processing and marketing immediately after harvest ($\bar{x} = 2.28$), sunk boreholes to ensure water availability/artificial irrigation ($\bar{x} = 2.22$), collected runoff water in ditches during drought periods ($\bar{x} = 2.16$), constructed drainage systems or dams within farms or households ($\bar{x} = 2.05$), and changed careers ($\bar{x} = 1.58$).and change profession entirely ($\bar{x} = 1.58$).

IPCC (2007) identified several adaptation strategies, such as the construction of a drainage system or dam with the farm/household, practicing shifting cultivation and changing the planting date, using improved crop varieties, skipping storage but processing and marketing immediately after harvest, mix cropping, use early maturity plants: and financial management for farm protection may involve giving the affected farmers financial support, vaccination against disease, changing from production of agriculture to marketing.

Similarly, the findings of this study are supported by Ifeanyi-Obi & Nnadi (2014), who identified planting of different varieties of crops, early harvesting of crops, use of varied dates of planting for crops, use of pest-and-disease-resistant crop varieties, diversification into non-farming income activities, more frequent use of family labour to reduce the production cost, more frequent weeding and use of indigenous knowledge as main adjustment measures used by farmers in the southern part of Nigeria.

Constraints to the use of Adaptation Strategies of Climate Change among Women Vegetable Farmers

The outcome of constraints to the use of adaptation strategies to climate change among female vegetable farmers is displayed in Table 5. It shows that the women vegetable farmers agreed that the significant constraint experienced was limited access to agricultural extension officers ($\bar{x} = 3.65$) as the major constraint in using an adaptation strategy to climate change. Farmers who have contact with extension agents will practice better adaptation strategies than those with no or low contact with extension agents. The extension agents provide relevant and timely information to farmers to enable them to understand the adaptation strategies available and make decisions about practicing them. The study of Ofuoku & Okompu (2022) opined that contacts with extension agents expand farmers' knowledge of modern farming techniques, address their challenges, and improves communication between advisors and research institutions.

Inadequate access to timely information on the weather ($\bar{x} = 3.50$) and lack of credit facilities ($\bar{x}=3.24$) were also seen as barriers to farmers' use of adaptation strategies. Funds are vital for any meaningful agricultural development, and adequate access to credit will enable farmers to adopt adaptation strategies. When farmers lack funds, they will be unable to practice some climate change adaptation options, which may be costly (Ikehi et al., 2022). Female vegetable farmers were also constrained by inadequate farm labour ($\bar{x} = 3.21$), limited farm sizes ($\bar{x} = 2.92$), unpredictable weather ($\bar{x} = 2.91$), inadequate access to water resources ($\bar{x} = 2.67$). These findings align with Kuang et al. (2020), who state that farmers' decisions to adopt climate change adaptation practices are constrained by their limited physical, natural, social, financial, or human capital. The findings further corroborate the findings of Ndamani & Wantanble (2015), who observed some constraints to farmers' adaptation strategies to climate change, such as high cost of farm inputs, untimely access to information on the meteorological conditions, lack of credit facilities, inadequate agricultural subsidies, poor access to agricultural extension officers and limited farm size.

CONCLUSION AND RECOMMENDATION

Conclusively, climate change affected vegetable farmers negatively as the women farmers faced quality, quantity and economic losses of vegetables in the study area. These women vegetable farmers perceived the effects of climate change majorly as loss of suitable land for agriculture, which negatively increased hunger and malnutrition, flooding farmland and fire outbreaks. The farmers had started practicing some adaptation strategies such as planting deeper than the usual planting depths to prevent scorching, using improved crop varieties and collecting runoff water in ditches for drought periods to reduce the effect of climate change on vegetable production. However, vegetable farmers were constrained in using adaptation strategies to climate change such as limited access to extension contact, inadequate access to timely information on weather and adequate credit facilities. Therefore, the study recommends that women vegetable farmers should be encouraged to have more contact with extension agents to give them access to appropriate adaptation strategies that can minimize the effects of climate change on vegetable production. Also, vegetable farmers should practice effective adaptation strategies to prevent flooding that can cause a reduction in available land for vegetable production. Vegetable farmers should be encouraged to come together and pool their resources to access credit facilities that enable them to practice modern adaptation strategies.

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APPENDICES

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Table 1: Awareness of climate change

Statement	Percentage
Awareness of climate change	98.88
Experienced longer dry seasons,	94.44
Drying up of streams or rivers	80.00
Severe flooding	100.00
Delayed onset of rainfall	88.88
Excessive rainfall	96.67

Source: Field Survey, 2023

Table 2: Sources of Information on Climate Change

Source of information	Frequency*	Percentage
Extension Agents	85	94.4
Farmers Association	78	86.7
Friends and Relatives	45	50.0
Internet	38	42.2
Radio	69	76.7
Television	34	37.8
Bulletin/ Posters	28	31.1
Newspaper	37	41.1
GSM phone	78	58.9
Fellow Farmers	67	74.4

Source: Field survey, 2023; *Multiple responses are recorded

Table 3: Perceived Effects of Climate Change on Vegetable Production

Perceived effects	Mean
Decrease in Vegetable yields	2.11
Low quality of vegetables	3.17
Failure of the crop	2.53
Increased postharvest losses	3.00
Increased Pest and disease infestation of crop	2.09
Loss of revenue / low income of the farmers	3.09
Delay in maturation of vegetables	3.02
Reduced length of growing season	2.72
Poverty	2.62
Increased hunger and malnutrition	2.89
Scorching of seedlings	2.89
Flooding of Farmland	2.92
Famine	2.82

Source: Field survey, 2023. Aggregate mean (\bar{x} = 2.76); Mean value < 2.50 indicate rejection while Mean value >2.50 implies acceptance.

Table 4: Adaptation Strategies to Effect of Climate Change on Vegetable Production.

Adaptation Strategies	Mean
Using improved crop varieties	3.10
Changing the planting/stocking time	3.13
Use of mulching materials for crops	2.70
Using early maturity plants	2.70
Using nursery for transplantable crops	2.77
Practicing mix cropping	2.96
Practicing shifting cultivation/crop rotation	2.61
Avoidance of scorching by planting vegetables deeper than the usual planting depth	2.98
Using intensive fertilizer and or manure application for crop production	2.62
Change of harvesting date	2.70
Expansion of Farmland	2.57
Skipping storage but processing and marketing immediately after harvest	2.28
Changing from production of agriculture to marketing	2.60
sunk boreholes to ensure water availability/artificial irrigation	2.22
Collected of runoff water in ditches during drought periods	2.16
Elevating the farm walls with sandbags or blocks to channel the floodwater	3.30
Constructed drainage system or dam within farm or household	2.05
Change profession entirely	1.58

Source: Field Survey, 2023. Mean value < 2.50 indicate rejection while Mean value >2.50 implies acceptance.

Table 5: Barriers to Adaptation Strategies to Effects of Climate Change on Vegetable

S/N	Barriers to Adaptation	Mean
1	Unpredictable weather condition	2.91
2	Limited farm size	2.92
3	Inadequate farm labour	3.21
4	Inadequate access to timely information on weather	3.50
5	Inadequate access to water resources	2.67
6	Lack of credit facilities	3.24
7	Limited access to extension contact	3.65

Source: Field survey, 2023.