OBAFEMI AWOLOWO UNIVERSITY

EFFECTS OF CLIMATE VARIABILITY ON THE YIELD OF SELECTED CROPS IN RAIN FOREST BELT ECOLOGICAL ZONE OF NIGERIA.

By

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(SCP10/11/H/0852)

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN ENVIRONMENTAL CONTROL AND MANAGEMENT TO THE INSTITUTE OF ECOLOGY AND ENVIRONMENTAL STUDIES, FACULTY OF SCIENCE,OBAFEMI AWOLOWO UNIVERSITY, ILE- IFE.

2013

CERTIFICATION

We hereby certify that this study was executed by Mr. Adebolu Olanrewaju ADEYEMO and approved as part of the requirements for the award of the degree of Master of Science in Environmental control and Management of Obafemi Awolowo University, Ile- Ife, Nigeria

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DEDICATION

This research work is dedicated to the Almighty God the source of all wisdom and understanding who in his infinite mercy and grace sustained me from the beginning of this course of study and purposed that I should accomplish it successfully.

ACKNOWLEDGEMENTS

I am very grateful to the Almighty God for His grace and mercy upon me for making my academic pursuits this far very successful. Only He could have made this dream come true.

My profound gratitude goes to my supervisor, Dr.O.O. I Orimoogunje whose scholarly, fatherly and spiritual guide and advice made this work to see the light of the day. I am very grateful sir. My extreme gratitude also goes to the Director, Institute of Ecology and Environmental studies, O.A.U, Ile Ife Dr. O.O. Awotoye who also doubles as my co supervisor for his constructive and fatherly advice. May God continue to be with you sir.

Worth of mentioning here is the assistance received from Space Application and Environmental Laboratory (SPAEL). I am also grateful to all the academic and non academic staff of the Institute of Ecology and Environmental Studies for their assistance. I appreciate all the authors whose publications I benefited from during the course of this research.

My Elderly siblings deserve unreserved acknowledgement and appreciation. I appreciate my Elder Sister Mrs. G.A Adeyele for her moral and financial support which enables me to complete this research work and this program. I appreciate Mr. O.A. Adeyemo, Mrs. Tejumade Olalekan and Mr. Adewuyi Adeyemo for their support and encouragements. I will not forget the vital contribution of Mr. Adeyinka Adeyemo whose input and support always bail me out of my dilemma in the course of this program. God will always help you in Jesus Name. He will grant all of you long life and good health to reap from your investment. Amen.

My friends, Mr. Zachariah Orofin, Mr. Jimba Adeboye, Miss Omisore Oreoluwa, Miss Titilayo Akinsanmi and Mr. Kunle Olawole for your numerous prayers, support and encouragements that

propelled me towards the completion of this research. You are a big part of my success story and I thank God for your lives.

To one special person I had in my life, whose encouragement prompted me to further my academic at this time, I still say thank you. Finally, I apologize with all sincerity to anyone whose contributions were not mentioned in these acknowledgements.

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ABSTRACT

The study investigated the impact of temperature and rainfall on the yield of maize, yam, cassava, groundnut and okra in the rainforest belt ecological zone of Nigeria. It also identified climatic variability and evaluated the impact of rainfall and temperature with a view to suggesting ways of adapting to recent climatic trends to make crop production sustainable and less risky.

The study was carried out in the rainforest belt ecological zone of Nigeria. Secondary data sets were used for this study. The data included the average annual rainfall, average annual temperature and average annual crop yield output of selected staple food crops (maize, yam, cassava, groundnut and okra) from 1999 to 2010 and from six stations (Benin, Ibadan, Ijebu-Ode, Ondo, Oshogbo and Owerri) in the rainforest belt ecological zone. Data on rainfall and temperature were collected from the Nigerian Meteorological services (NIMET), Oshodi Lagos. Crop yield data were obtained from the National Programme for Agriculture and Food Security, Federal Ministry of Agriculture and Rural Development Report of 2009 agricultural production survey, the annual publication of the National Bureau of Statistics, Abuja and Food and Agriculture Organization annual publications. Crop yield data and climate data were subjected to descriptive statistics. Climate response function was estimated using regression model by incorporating weather variable to examine the impact of climate variability on crop yield production.

The peak of temperature for all the stations within the period of study was 29.42°C and the lowest was 25.83°C. The peak annual rainfall for all the stations within the period of study was

3080.5 mm and the lowest was 840.56 mm. The peak value for crop yield production for maize was 350.0 ‘000/ha, for yam was 132.0 ‘000/ha, for cassava was 260.0 ‘000/ha, for groundnut was 20.0 ‘000/ha and 35.0 ‘000/ha for okra. The study revealed that 65% of the variance of maize yield production could be explained by temperature and rainfall and 35% could be explained by other factors. Also 69% of the variance of yam yield production could be explained by temperature and rainfall and 31% could be explained by other factors. 55% of the variance of groundnut yield production could be explained by temperature and rainfall and 45% could be explained by other factors. In addition, 28% of the variance of cassava yield production could be explained by temperature and rainfall and 72% could be explained by other factors, and 39% of the variance of okra yield production could be explained by temperature and rainfall while 61% could be explained by other factors.

The study concluded that temperature and rainfall were not the only determinants of crop yield production of maize, yam, cassava, groundnut and okra in the study area.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Climate change is one of the most serious environmental threats facing mankind worldwide. It affects agriculture in several ways, including its direct impact on food production. Climate change, which is attributable to the natural climate cycle and human activities, has adversely affected agricultural productivity in Africa (Ziervogel *et al*., 2006). Available evidence shows that climate change and its impact are global, likewise its impacts; but the most adverse effects will be felt mainly by developing countries, especially those in Africa, due to their low level of coping capabilities (Nwafor, 2007; Jagtap, 2007). Nigeria is one of these developing countries (Odjugo, 2010). As the planet warms, rainfall patterns shift, and extreme events such as droughts, floods, and forest fires become more frequent, the results are poor and unpredictable yields, thereby making farmers more vulnerable, particularly in Africa (UNFCCC, 2007).Peasant farmers (who constitute the bulk of the poor in Africa), face prospects of tragic crop failures, reduced agricultural productivity, increased hunger, malnutrition and diseases. It is projected that crop yield in Africa may fall by 10-20% by 2050 or even up to 50% due to climate change(Jones and Thornton, 2003), particularly because African agriculture is predominantly rain-fed and hence fundamentally dependent on the vagaries of weather.

The variability of the climate has been a topical issue in a sustainable environment as the crop yield and production is very important to the economy and the livelihood of the people of Nigeria and the world at large. The Rainforest ecological Zone of Africa permits the cultivation of a variety of crops that emerged in earlier centuries in response to local conditions (Onyekwelu *et al*., 2006, Ziervogel *et al*.2008). It follows therefore that any change in climate may impact the agricultural sector in particular and other socio-economic activities in general. Climate change could have both positive and negative impacts and these could be measured in terms of effects on crop growth, availability of soil water, soil fertility and erosion, incidents of pests and diseases, and sea level rise (Onyekwelu *et al*., 2006, Ziervogel *et al*., 2008; Semenov 2009, Butterworth *et al*. 2009).

Temperatures throughout Nigeria are generally high with annual mean of about 27°C while diurnal variations are more pronounced than seasonal differences (Salami and Mathew, 2009). Rainfall is the key climatic variable and there is a marked alternation of wet and dry seasons in most areas (Adefolalu, 1986; Olaniran, 1991a; Olaniran, 1991b). During wet seasons ,major portion of the country come under the influence of moisture-laden tropical maritime air mass, spatial variability is evident in the irregular distribution of rainfall at both short-time scale and average conditions while the temporal variability tends to be greater in the Southern and Northern parts of the country (Olaniran,1991b, Omotoso et al; 2007). The greatest total precipitation is generally in the Southeast, along the coast around Bonny (South of Port Harcourt and east of Calabar, where means annual rainfall is more than 3,000mm. Most of the rest of the southeast receives between 2,000 and 3,000mm of rain per year, and the southwest (lying farther north) receives lower total rainfall, generally between 1,250 and 2,500mm per year (Adefolalu, 1986; Olaniran, 1991a). The regularity of drought periods has been among the most notable aspects of Nigerian climate in recent years, particularly in the drier regions ofin the north (Olaniran, 1991a; Salami and Mathew, 2009). These drought periods are indications of the great variability of climate across tropical Africa and the most serious effects of which are usually felt at drier margins of agricultural zones or in the regions occupied primarily by pastoral groups.

The high degree of spatial variability of Nigerian rainfall is associated with the intense randomness of the convective process, which is the dominant rain- producing mechanism in the country with the attendant effects on the local features such as topography, vegetation and land cover type among others (Adefolalu, 1986; Omothoso *et al*., 2007)

Several factors that directly connect climate change and agricultural productivity include, average temperature increase; change in rainfall amount and patterns; rising atmospheric concentrations of CO2 pollution levels such as tropospheric ozone and climate variability or change with the associated extreme events such as drought and flooding (Butterworth et al., 2009; Onyekwelu et al.,2006; Semenov, 2009;. Ziervogel et al., 2008.The consequences of changes in variability on the ecosystem may be as important as those due to climate change or shift in the mean climate (Hulme et al., 1999a; 1999b; Carnell and Senior, 1998). The relationship between climate change and food security is complex. Many factors influence food security, which means often the link is not even made between failed crops and changing weather patterns.

One of the banes of farming is the frequent complete loss of crops due to adverse weather conditions or pests. Changing weather patterns or extreme weather events, such as flood or droughts, can have negative consequences for agricultural production (IPCC, 2007; Misselhorn, 2005; Tadross, *et al*., 2005; Ziervogel *et al*., 2008). Rural communities dependent on agriculture in a fragile environment are continuously facing an immediate risk of increased crop failure. Consequently, there is less access to food, which forces the price of the little available food product out of reach of the common man. This translates to secondary effect on the living standard of farmers, fishers and forest-dependent people who are already vulnerable to poor living conditions.