

4
THE OCCURRENCE OF AGRICULTURAL DROUGHT
AND ITS IMPACT ON MAIZE PRODUCTION
IN KISUMU DISTRICT, KENYA "

BY

BEATRICE A. ADERA

A THESIS SUBMITTED IN PARTIAL FULFILMENT FOR REQUIREMENT
OF THE DEGREE OF MASTER OF SCIENCE IN GEOGRAPHY
(CLIMATOLOGY) IN THE UNIVERSITY OF NAIROBI.

UNIVERSITY OF NAIROBI LIBRARY



0100761 6

HIS THESIS HAS BEEN ACCEPTED FOR
THE DEGREE OF... MSc 1996
AND A COPY MAY BE PLACED IN THE
UNIVERSITY LIBRARY.

UNIVERSITY OF NAIROBI

Abstract

This study was an attempt to determine the effect of Agricultural Drought on Maize production in Kisumu District, Kenya. Maize is the most popular cereal in the district and is usually given preference over other cereal crops because it is considered more palatable. The broad objective of this study was to determine the onset of the rainy season(s) as a basis of determining the optimum planting time of maize in the area, given the nature and sequence of rainfall occurrence at the beginning of the year, and the soil moisture storage throughout the growing season. The relationship between soil moisture deficit and maize yields was also examined in an attempt to explain the variation in maize yields over the years.

Data for this study were largely obtained from various secondary sources. The data types collected for this study included the ten day totals for rainfall, relative humidity, wind-run and pan evaporation. Data on soil moisture storage capacities for representative soils of each division and annual maize yields per division were also collected.

The sample of stations considered for this study was based on the consistency of rainfall records for the study period 1971 to 1990. The spatial distribution of the stations was also looked at in terms of the rainfall gradients and distribution within the different divisions. Twelve stations were finally selected for this study based on these criteria.

The status of the soil moisture condition during the growing season was determined and then related to the maize yields. The onset of the growing season was determined on the basis of ten day (decadal) rainfall totals and a water balance analysis was performed to establish the water deficit and surplus periods within the growing season. The onset of the growing season was defined as rainfall events beginning on or after the first decade of February each year

when the accumulated rainfall total was 30mm or more. Rainfall in the next two decades was also expected to exceed half the mean decadal potential evapotranspiration which was estimated as 20mm given the mean potential evapotranspiration values for the area. Onset definition was based on rainfall amounts received and their consistence over time. The growing season was assumed to begin once onset of the rainy season was achieved.

The cumulative water balance procedure was used to determine the water deficit and surplus periods within the growing season. Soil moisture deficit conditions occurred when rainfall and soil moisture storage were not able to meet the crop water requirements (ET_{crop}). Maize crop evapotranspiration was estimated using the pan evaporation method. The evaporation pan values used were from the Class A pan evaporimeter for Kisumu and they were transformed by a factor of 1.05 to convert them to equivalent U.S.A Class A pan measurements. The soil moisture retention characteristics were estimated using the procedure developed by Braun and Van de Weg (1977) which is based on soil depth and texture.

Regression analysis and the analysis of variance were used to establish whether there was any significant relationship between the soil moisture deficits and the maize grain yields. The significance was tested using the F-test at $\alpha = 0.05$.

Rainfall events in Kisumu District were found to begin, on average, during the first decade of March (decade 7) and the planting dates for each season were assumed to follow onset. The entire district was found to experience one main rainy season with a few areas experiencing a second rainy season beginning in September (decade 25) which was in most cases too short for successful cultivation of the maize varieties presently grown. The month of March was found to be the optimum planting time for the maize crop in the district because most of the

observed onset dates occurred during this month.

The water balance results revealed that in most parts of Kisumu District, and for most seasons, rainfall met the crop water requirements and surplus moisture conditions were experienced. Soil moisture deficits were rare in Maseno, Nyabondo and Koru areas with amounts ranging between 10 to 40mm per season for the few years they were experienced. Deficit soil moisture conditions were prevalent in the areas represented by Nyakwere and Kisumu Meteorological Stations, both located near the shores of Lake Victoria. These areas experienced fairly high frequencies of deficit soil moisture conditions which on average lasted between 3 and 9 decades. At Nyakwere, the 1982 and 1984 seasons experienced very low rainfall events throughout the year and it was not possible to determine the onset of the rainy season for these years based on our onset definition criteria. Surplus soil moisture conditions ranging between 20 and 40mm on average were experienced around Kisumu Meteorological Station. This was attributed to the low moisture retention capacity of the soils found in the area.

Low correlations were found when seasonal soil moisture deficits were correlated and regressed against maize yields. Soil moisture deficits were found to be significantly related to the maize yields in Nyakach and Muhoroni divisions and these deficits accounted for 20 percent and 19 percent of the variability in maize yields in both divisions respectively. Moisture deficits during the moisture sensitive stages of maize growth gave very low correlations when correlated and regressed against maize yields for all divisions except Nyakach where a correlation coefficient of 0.19 was found.

On the basis of the results obtained in this study, it was concluded that there was adequate soil moisture in most parts of the district to support maize growth except in Winam

Division where farmers should be advised to plant drought resistant and short season maize varieties to enable them to achieve maximum yields. The variability in yields could be attributed to other climatic and non-climatic factors which were not determined as they fell outside the scope of this study. On the basis of the findings from the study, it is recommended that improved soil and crop management practices and the selection of the right cultivars should be enhanced in the district to enable maximum maize yields to be achieved.