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Profile of Rainfall Change and Variability in the Northern Nigeria, 1953-2002.

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Abstract: Rainfall data spanning a period of 50 years (1953-2002) for 9 stations in northern Nigeria were used to determine the trend in annual rainfall for the region. 5-year running mean was calculated for annual rainfall for the selected stations. The decadal means were compared with the long-term mean. Evidence from the nine stations considered shows that there is significant increase in annual rainfall amount in the last decade of the study. It means, therefore, that we are experiencing wetter conditions in the sudano-sahelian zone of Nigeria. Increasing annual rainfall totals portend both good and ill. Good, because there is improvement in water supply to an otherwise marginal area. Ill, because flooding, dam collapse as a result of excessive rainfall on an impervious terrain could lead to damage to life and property.

Key words: Rainfall, change, variability, agriculture, irrigation and running-mean

INTRODUCTION

Rainfall Climate: The Sudan-Sahel savannah bioclimatic zone is characterized by a savannah type climate with alternating wet and dry seasons. Rainfall in this region varies from 1500mm per annum in the southern part to 400 mm in the northern part. The rainy season lasts from about 7 months (April to October) in the southern part to as low as 3 months (July to September) in the northern part. In between cases for Kano State were earlier exemplified (Ati *et al*., 2002). The rainfall intensity is very high between the months of July and August. As a result though the environment is generally dry, crops are frequently lost through too much rain. It also results in rapid surface run-off, soil erosion and water-logging (Pollock, 1968; Udo, 1970). Besides, inter annual variability is high (Iwegbu, 1993). Because of the large inter-annual variability of rainfall, this zone is subject to frequent dry spells, often resulting in severe and widespread droughts, capable of large scale destruction of plants, animals and human life (e.g. Ati *et al*., 2002).

The gross features of rainfall patterns in this region, as in other parts of the country are usually in association with what is often called the Inter Tropical Discontinuity (ITD) (Nicholson, 1981; Kanote, 1984; Hayward and Oguntoyinbo, 1987; Oladipo, 1993).

The movement of the ITD northwards across the country between January and August, and its retreat from the southern fringe of the Sahara desert, after August, cause much of Nigeria to experience seasonal rainfall (Olaniran and Summer, 1989). The ITD itself is the boundary at the ground between the dry Tropical Continental (cT) air of northern origin and the moist Tropical Maritime (mT) air of southern origin.

It has been argued that the convergence of trade wind and monsoonal airflow, in the region of the ITD, is unable to produce sufficient vertical motion (and depth of clouds) to induce rainfall (Hulmes and Tosdevin, 1989). The relevance of the ITD therefore lies in its provision of a framework for following the south / north motion of the rain bearing maritime air mass (mT). Within the mT air mass is enclosed a number of rainfall producing systems, such as the disturbance lines (especially the easterly waves), squall lines and the two tropospheric jet streams. It is the magnitude of these systems that influences the amount and seasonal distribution of rainfall over the region (Kamara, 1986; Hayward and Oguntoyinbo, 1987; Muller and Oberlander, 1987; Ayoade, 1988; Hastenrath, 1991).

Agriculture: Agricultural production in the zone as in many parts of the country is largely rain-fed. Agricultural production follows the rhythm of the seasons with most of the farming activities occurring during the rainy season which last between 7 months in the southern part of the zone to 4 months in the extreme north. During the dry season, secondary occupations like weaving (of caps and mats) and dyeing are practiced. The short rainy season limits crop production to only those crops that can grow and mature within a short time. These crops include millet, sorghum, ground nuts, maize, rice and hungry rice (acha) (Adamu, 2000). Agriculture is largely of the subsistent type and land holding are characteristically small and fragmented. Most of the farming activities is carried out by subsistent farmers who grow these crops only for food and the little left over is sold in the market to meet urgent financial needs. It is based on extensive cultivation and the main tools consist of hoes, cutlasses,

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axes and knifes. There is much dependence on manure, and recently, artificial fertilizers to prevent loss of soil fertility. Irrigation farming is also much practiced here. The fadamas (low laying areas) are used for dry season cropping of vegetables and sugar cane (e.g., Chambers, 1990).

Due to the heavy dependence on rainfall for agricultural production any significant variability in the annual amount of rainfall could have an equally significant effect on agricultural production. Earlier studies in this region indicate declining annual rainfall totals creating scarcity of water for agricultural production and needs for more effective water resources development (Oladipo, 1993; Ati *et al*., 2002). Most of these studies were based on records terminating in the late 1980s and the early 1990s. This study is an attempt to update information on trends in annual rainfall based on current records.

MATERIALS AND METHODS

The study was carried out for northern Nigeria between latitude 10ºN and 14ºN and longitude 4ºE and 14ºE, (Fig. 1) which lies immediately to the south of Sahara desert. Rainfall data for 9 stations spanning a period of 50 years (1953-2002) were used for the study. The series of data for the nine selected stations was tested for normality using the Microsoft Excel software. The normalizing limit is 95% of the error margin (Brazel and Balling, 1986). If the absolute values of Z_1 and Z_2 are greater that 1.96, a significant deviation from the normal curve is indicated at 95% confidence level. were used for the study. 5-year running mean was calculated for annual rainfall for the selected stations.

RESULTS

Yelwa: From Fig. 1, 5-year running-means show annual rainfall above the long-term mean from the beginning of the data up to the late 1960s. From the late 1960s to the late 1990s the rainfall was below the long-term mean. The rainfall started increasing from that point to the end of the data.

Kaduna: From Fig. 2, 5-year running-means show annual rainfall above the long-term mean from the beginning of the data up to the early 1970s. From the early 1970s to the late 1990s the rainfall was below the long-term mean. The rainfall of the remaining years nearly approximates the long-term mean.

Zaria: From Fig. 3, 5-year running-means show annual rainfall above the long-term mean from the beginning of the data up to the late 1960s. From the late 1960s to the early 1990s the rainfall was below the long-term mean. The rainfall started increasing from that point to the end of the data.

Potiskum: From Fig. 4, 5-year running-means show annual rainfall above the long-term mean from the beginning of the data up to the late 1960s. From the late 1960s to the early 1990s the rainfall was below the long-term mean. The rainfall started increasing from that point to the end of the data.

Maiduguri: From Fig. 5, 5-year running-means show annual rainfall above the long-term mean from the beginning of the data up to the early1980s. From the early 1980s to the late 1990s the rainfall was below the long-term mean. The rainfall started increasing from that point to the end of the data.

Gusau: From Fig. 6, 5-year running-means show annual rainfall above the long-term mean from the beginning of the data up to the early 1970s. From the early 1970s to the early 1990s the rainfall was below the long-term mean. The rainfall started increasing from that point to the end of the data.

Kano: From Fig. 7, 5-year running-means show annual rainfall above the long-term mean from the beginning of the data up to the late 1960s. From the late 1960s to the early 1990s the rainfall was below the long-term mean. The rainfall started increasing from that point to the end of the data.

Sokoto: From Fig. 8, 5-year running-means show annual rainfall above the long-term mean from the beginning of the data up to the early 1970s. From the early 1970s to the late 1990s the rainfall was below the long-term mean. The rainfall started increasing from that point.

Katsina: From Fig. 9, 5-year running-means show annual rainfall above the long-term mean from the beginning of the data up to the mid 1970s and from the late 1970s up to the mid-1980s and from the late 1990s up to the end of the period. Mostly from the mid-1980s to the late 1990s is below the long-term mean.

DISCUSSION

Evidence from the nine stations considered shows that there is significant increase in annual rainfall amount in the last decade of the study. The decades between 1963 and 1992 for most of the stations shows decrease in annual rainfall totals. It means, therefore, that we are experiencing wetter conditions in the sudano-sahelian zone of Nigeria. This is at variance with earlier conclusions drawn on the rainfall trends in the zone (e.g., Oladipo, 1993) However, these previous studies were based on data covering up to the early 1990s. Studies that include recent data will arrive at the same conclusion with this study. Increasing annual rainfall totals portend both good and ill. Good because there is improvement in water supply to an otherwise marginal area. Ill because

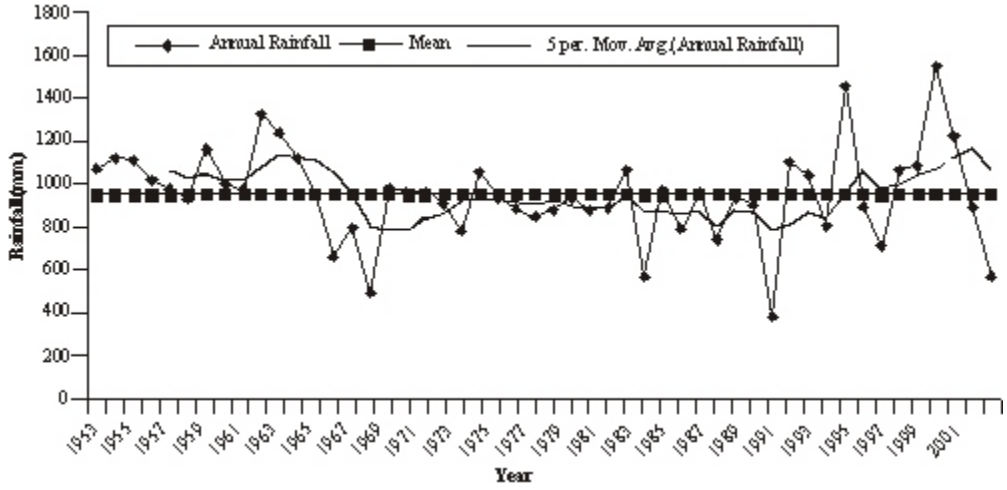

Fig 1: Annual rainfall trends for Yelwa

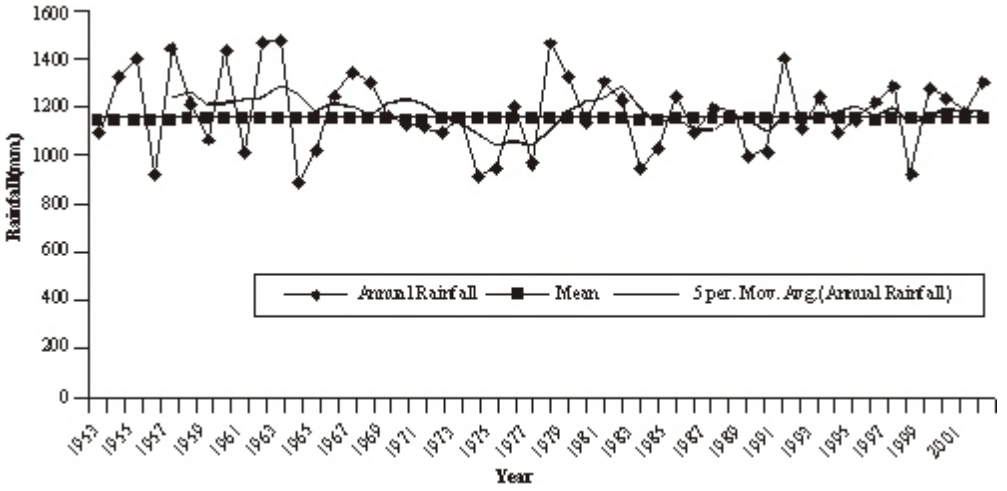

Fig 2: Annual rainfall trends for kaduna

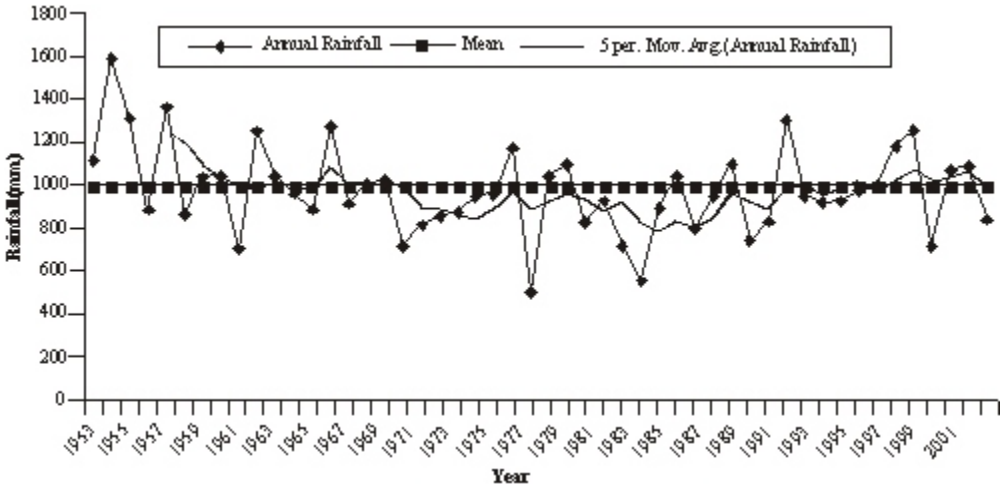

Fig 3: Annual rainfall trends for Zaria

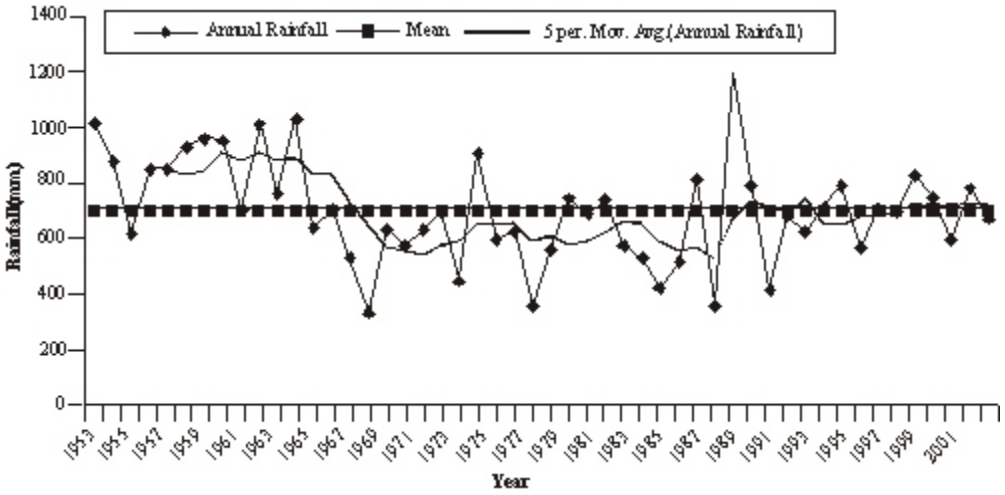

Fig 4: Annual rainfall trends for Potiskum

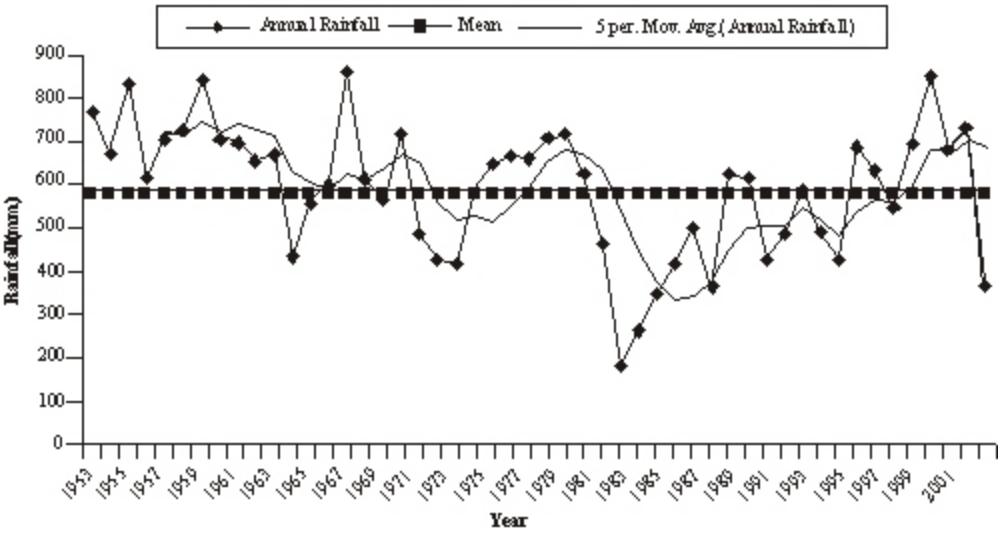

Fig 5: Annual rainfall trends for Maiduguri

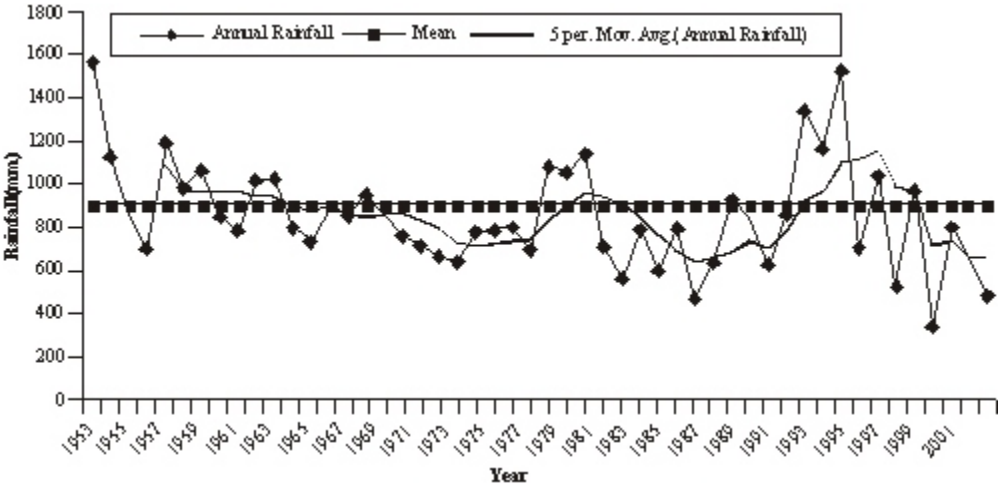

Fig 6: Annual rainfall trends for Gusau

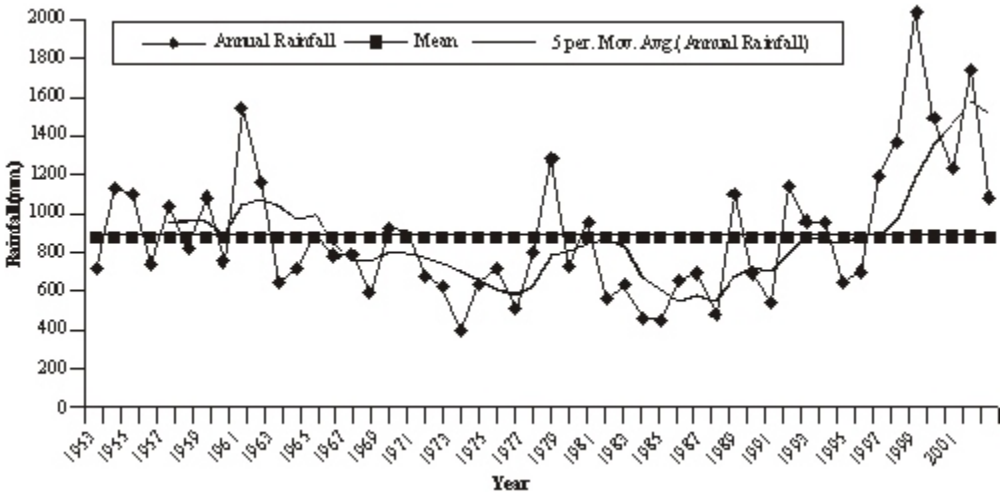

Fig 7: Annual rainfall trends for Kano

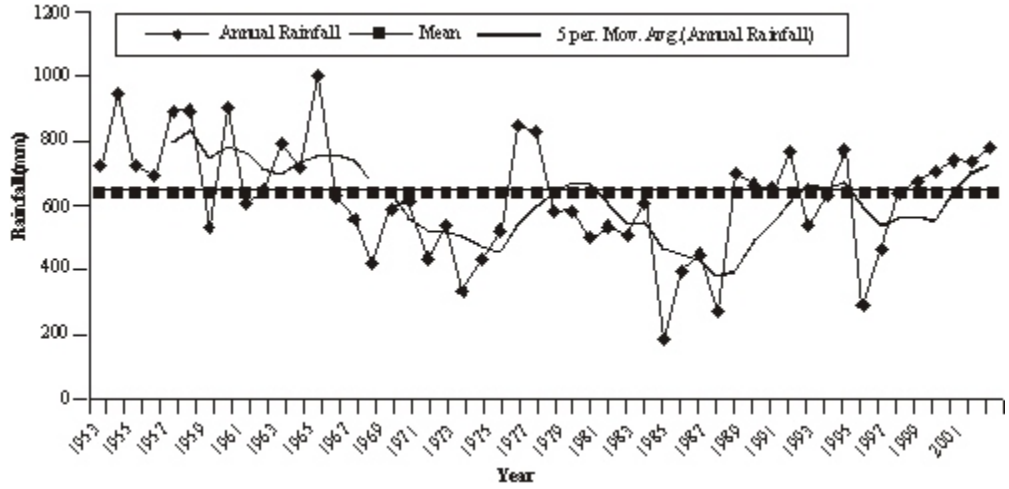

Fig 8: Annual rainfall trends for Sokoto

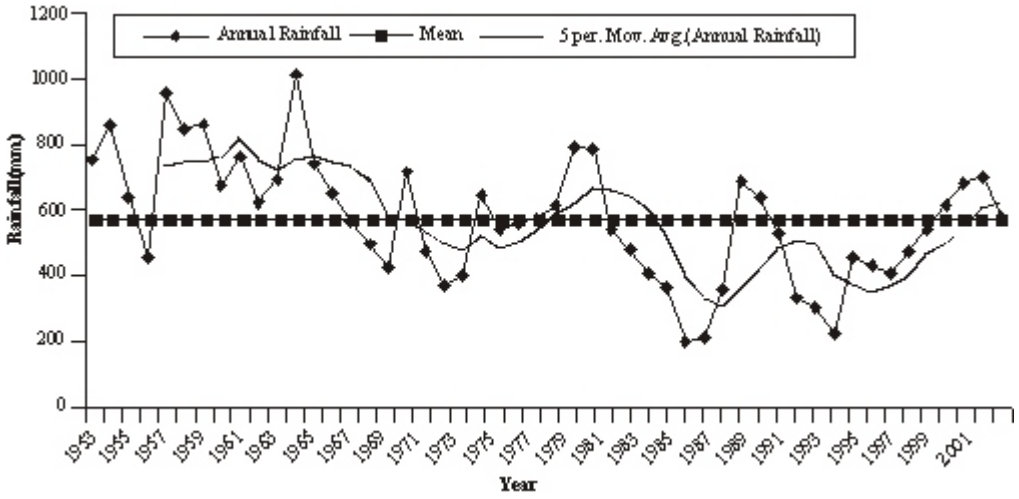

Fig 9: Annual rainfall trends for katsina

flooding, dam collapse as a result of excessive rainfall on an impervious terrain could lead to damage to life and property.

CONCLUSION

Agriculture in the study area is largely rain fed. Therefore, the amount of rain that falls in the area is critical to agricultural planning and development. Rainfall in the study area has generally been on the increase in the last decade of the study period. This is good news to the farmers. Though, varieties that have been produce to withstand water stress may be endangered if the current trend continues. Also, water available for irrigation purposes is on the increase creating a favourable condition for irrigation agriculture. The water resources of the study area are also largely dependent on rainfall amounts. Increasing rainfall means increasing recharge of the various surface and underground water resources. This increase can be harnessed to create adequate water storage against periods of shortage. Dam construction should take into consideration the water that is received from increasing rainfall. Models built on the perceived decreasing rainfall have to be reviewed and the trends should still be closely monitored.

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