

# Long-term variations in regional rainfall and in land degradation Example in West Africa

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## Introduction

The savanna zone of West Africa has been stricken by severe recurrent droughts in the last two decades. In the nine states of the Sahelian zone, the population has doubled over the period 1960-1988. The combination of these two processes has worsened erosion problems in the region. This presentation will focus on the evolution of rainfall intensity, runoff production and erosion.

## Droughts

Three main periods can be distinguished during the 20th century: (1) from the beginning of the century to the late 40's, annual variability of rainfall is high. The higher or below average periods are limited to 2 or 3 consecutive years. In particular, three severe droughts occurred in 1911-1914, 1941-1942 and 1947-1949. (2) from 1950 to 1968: this time-series was continuously exceeding average. (3) since 1969, annual rainfall remains below average with two major droughts in 1972-1974 and 1983-1985. The recent drought has resulted in a pronounced southward shift of the isohyets, particularly in the already driest zone.

## Rainfall intensity

Based on daily rainfall records from 20 stations in Burkina Faso over a period of nearly 50 years, daily rainfall higher than 40 mm shows a substantial decrease since 1969. However, no concurrent decrease was observed, neither for high intensity rainfall nor for the depth of the daily rainfall of decennial frequency (Albergel, 1986). In some locations, this rainfall depth has even increased (Fig.1).

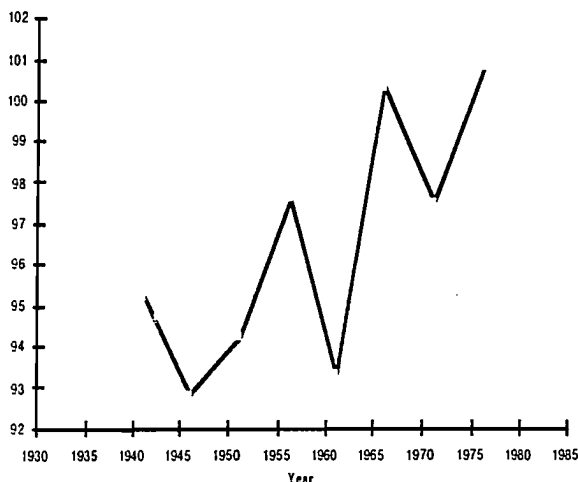


Fig 1. Fifteen-year running average of decennial daily rainfall in Ouagadougou for the period 1934-1983 (after Albergel, 1986).

## Runoff production

One of the most significant changes in land-use patterns have been the dramatic shortening of the fallow period to meet increasing demand for agricultural land. Another striking feature is the clearing of marginal land, especially the plateaux or the stripes of land along the water courses. This expansion of cultivated surface tend to balance the decreasing yield, or income in the case of commercial crops subject to external market fluctuation. The combination of these processes, with no change in exceptional precipitation, has led to a pronounced increase in runoff in the Sahelian zone, a slight increase in the Sahelo-Sudan zone, and a minute increase in the Sudan zone (Fig. 2). Such results suggest that any further decrease in precipitation in the most arid zone would induce a further increase in runoff production.

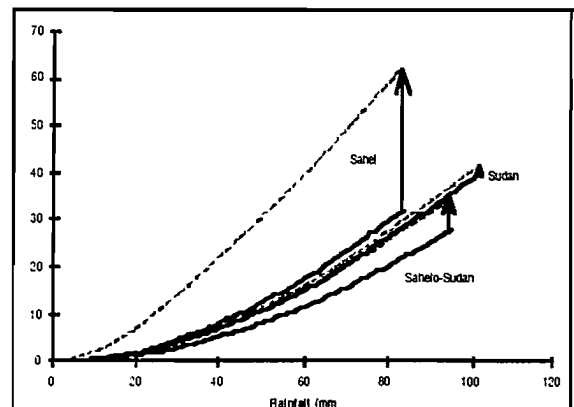


Fig. 2. Changes in runoff production between the 50's and the 80's for three watersheds of Burkina Faso of few 10-m<sup>2</sup> for an unchanged ten-year return period rainfall (after Albergel, 1987).

## Soil erosion

In such a region, it is difficult to study the effect of kinetic energy upon erosion in isolation from the structural change of the soil surface. Comparing the effect of a variety of intensities and kinetic energies for a given rainfall depth, Collinet (1988) showed in northern Burkina Faso that any increase in kinetic energy led to a decrease in erosion in clayey soils and to a very slight increase in sandy soils. This must be ascribed to the complex interactions between kinetic energy, surface degradation and erosion. For clayey soils, the rainfall impact results in a compacted and denser plasmic seal (or "erosion crust") which tends to protect the soil underneath from further erosion, at least temporarily, contrary to sieving crusts formed on sandy soils.

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In a Burkinabe watershed within less than 25 years, the surface of cultivated land has doubled, fallow land was halved, shrub savannah was reduced from 80% to 45% while severely eroded patches increased 20-fold (Albergel and Valentin, 1988). In a less densely populated region of Burkina Faso bare and crusted patches increased 6-fold within 28 years (Serpantié et al., 1991).

### **Conclusion**

Decreased precipitation does not invariably implies reduced water erosion.

### **References**

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