Rainfall variability and kinetic energy in Southern Nigeria

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Abstract

A decreasing trend of rainfall has been observed in West Africa, where rainfall erosivity is also considered to be high. Therefore, this study was carried out to evaluate the variability of rainfall and its erosivity in two contrasting zones in southern Nigeria between 1977 and 1999 to understand the implications of climate variability on rainfall erosivity. The study sites were Ibadan, a sub-humid zone, and Port-Harcourt, a humid zone. Time of occurrence of rainfall, rainfall amount (A), intensity (I 15 and I 30), kinetic energy (E) and rainfall erosivity factor (R), were evaluated. Kinetic energy was estimated with Brown–Foster (BF) equation, making the rainfall erosivity (product of kinetic energy and intensity) to be designated as EI 30-BF and EI 15-BF. The frequency of rainfall during daylight (06:00–18:00 h) was 48% for Ibadan and 69% for Port-Harcourt. There were time-specific differences in daily rainfall occurrence between the zones, suggesting a strong influence of local effects on rainfall generation, such as, relief in Ibadan and proximity to the sea in Port-Harcourt. Annual E was 213 MJ ha−1for Ibadan and 361 MJ ha−1 for Port-Harcourt. Ibadan had a significantly higher daily E than Port-Harcourt because of higher intensity while Port-Harcourt had significantly higher annual E than Ibadan because of higher annual rainfall amount. Annual erosivity at Ibadan using the EI 30-BF was 9,742 MJ mm ha−1 h−1 whereas it was 15,752 MJ mm ha−1 h−1 at Port-Harcourt. Using the EI 15-BF, Ibadan had an annual value of 14,806 MJ mm ha−1 h−1 while Port-Harcourt had 20,583 MJ mm ha−1 h−1. Thus, annual rainfall erosivity was significantly higher in the humid than the sub-humid zone because of higher amount of rainfall but the reverse was the case with daily erosivity because of higher intensities in the sub-humid zone. Rainfall intensity was, therefore, a key measure of erosivity. There was a strong positive relationship between rainfall erosivity and rainfall amount. Between 1977 and 1988, 50–88% of the 12 years had rainfall erosivity which exceeded the long-term average but rainfall erosivity was less than the long-term average between 1989 and 1999. This suggested a decreasing trend in erosivity due to the decreasing trend in rainfall amount in West Africa. However, the trend did not imply lesser soil erosion and environmental degradation risks.

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