

THE PREDICTION OF RAINFALL INTENSITIES OF DIFFERENT DURATIONS AND RETURN PERIODS
FROM DAILY RAINFALL DATA IN TANZANIA. PART I.

by

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Climate is an essential factor in animal husbandry and also affects animal health, particularly with regard to the atmospheric conditions, the growth of pastures and the supply of drinking water.

It is often required to know what rainfall intensity to expect in a given area of a given duration and return period in order to be able to design drainage schemes, soil conservation structures, dam spillways, flood protection schemes etc. This can be determined by statistical analysis of data obtained from intensity recording rain gauges. Unfortunately there are only about twenty such rain gauges operated by the Tanzanian meteorological department in Tanzania, i.e. one rain gauge for approximately every 20,000 sq. miles. In view of the local variability of rainfall this cannot be considered adequate for prediction of intensities for most of Tanzania. However there are many meteorological stations that record daily rainfall in all parts of Tanzania. Accordingly the author has attempted to correlate daily rainfall data with rainfall intensities in Tanzania in order that intensities can be predicted wherever such data is available.

From daily rainfall data the highest rainfall occurring in one day for a given year can be determined. If this figure is determined for every year for which data is available the average of all these figures can be determined. Let this figure be h_{24} mm. This will be the rainfall with a duration of 24 hours and a return period of two years. i.e. intensity for return period of 2 years and duration of 24 hours

$$= h_{24} \text{ mm/day}$$

$$= \frac{h_{24}}{24} \text{ mm/hour}$$

- Let h_{tm} be the rainfall occurring of a duration t hours and a return period T years.

By applying multiple regression to the data available from the rainfall intensity gauges in Tanzania the author has shown that the relationship between these variables is as follows:

$$h = h_{24} (1.4 - 0.0058h_{24}) (0.83 + 0.24 \ln T) (0.62 + 0.2 \ln t)$$

(Details of the method used will be published in the next issue)

Thus the rainfall occurring for a given duration and return period can be determined from daily records using this equation. However this equation is rather complex and accordingly a graphical solution has been devised. The procedure for solving this equation graphically can be followed from the example given below.

Example

The daily rainfall records for Kigoma show that the maximum daily rainfall for each year were as listed in the table below. Predict the rainfall amount and intensity having a duration of 30 mins and a return period of 20 years.

Year	Date on which maximum daily rainfall occurred	Rainfall amount (mm)
1939	16th April	60.2
1940	3rd February	79.8
1941	9th November	51.6
1942	21st December	66.8
1943	8th November	57.9
1944	22nd February	33.5
1945	27th November	84.6
1946	18th April	94.0
1947	12th March	45.7
1948	29th October	81.5
1949	7th October	83.1
1950	18th January	96.8
1951	29th December	52.1
1952	21st April	50.0
1953	3rd February	77.7
1954	20th March	53.3
1955	19th March	65.5
1956	27th April	47.8
1957	11th December	70.1
1958	16th December	57.4
1959	3rd March	59.7
1960	10th March	106.7
1961	8th November	81.3
1962	5th April	60.2

$$h_{24} = \frac{60.2 + 79.8 + \dots + 81.3 + 60.2}{24} \text{ mm}$$

$$= 67 \text{ mm.}$$

This value of h_{24} can be found at point A on the attached graph. A vertical line through this point intersects the line for a return period of 20 years at point B. A horizontal line through this point intersects the line for a duration of 30 minutes at point C. A vertical line through this point intersects the h axis at point D. The reading of h at point D is 50 mm. Thus the required rainfall amount $h = 50 \text{ mm}$

