REPUBLIC OF KENYA

MINISTRY OF AGRICULTURE—NATIONAL AGRICULTURAL LABORATORIES

KENYA SOIL SURVEY

AVERAGE MONTHLY RAINFALL AS A PERCENTAGE OF THE ANNUAL RAINFALL IN KENYA AND TANZANIA, WITH PARTICULAR REFERENCE TO THE KENYAN COAST

by

H.M.H.BRAUN

Miscellaneous Paper M 14,November 1977

Kenya Soil Survey

S471/AW/HMB - 4/11/77

Average monthly rainfall as a percentage of the annual rainfall in Kenya and Tanzania, with particular reference to the Kenyan Coast

by

H.M.H.Braun

Miscellaneous Paper M 14,November 1977

Average monthly rainfall as a percentage of the annual rainfall in Kenya and Tanzania, with particular reference to the Kenyan coast.

Summary

For the comparison of the rainfall distribution of stations which differ very much in average rainfall, the monthly rainfall expressed as a percentage of the annual rainfall total is a useful measure. The figures show the changes in distribution from northern Kenya to southern Tanzania; from western to eastern Kenya; along two transects from the coast to 175km inland; and at various places in a 50km wide zone along the coast.

Introduction

While studying aspects of seasonal rainfall in Kenya's Eastern Province (Braun, 1975) it was found that for thirteen stations between Meru and Kibwezi the percentage of the average October-December rainfall which falls in October is well-correlated with latitude (linear correlation coefficient $r = -0.92$). Similarly a good correlation was found between the percentage of the average March-May rainfall which falls in March and latitude ($r = +0.84$). The negative sign of the correlation coefficient for October indicates that the rainbelt is moving southward in October while the positive sign of the correlation coefficient for March indicates that the rainbelt is moving northward in March. The correlation between the amount of rainfall in October and latitude is equally good ($r = -0.92$) but the correlation between the amount of rainfall in March and latitude is poor ($r = -0.41$) and the coefficient has the wrong sign. These findings indicate that for some purposes it has an advantage to express the monthly rainfall as a percentage of the seasonal or annual total. Therefore in the present study which originated from a study of rainfall distribution at the Kenya coast (Braun, in prep.), the monthly rainfall has been calculated as a percentage of the annual rainfall.

In the figures which follow for each station the name, number and the average annual rainfall are given. The number of a station indicates its approximate geographical position e.g. Moyale 86.39000 is between 86 and 87 degrees south of the northpole and between 39 and 40 degrees East of the Greenwich meridian. One degree near the equator measures 110 x 110 km approximately and the distance between Moyale (86.39000) in northern Kenya and Tunduru (101.37000) in southern Tanzania is roughly (101-86) x 110 = 1600km. The average annual rainfall of the stations used varies from 178 mm for Lodwar to 1798 mm for Kisii. The rainfall data were obtained from EAMD (1974, 1973) or earlier issues of the same serial publications.

Results and discussion

In fig 1 the monthly rainfall percentages from seven stations between northern Kenya and southern Tanzania have been plotted from January to December with a solid line and the period January-June is repeated with an interrupted lime; by taking a 1½-year period the rainy and dry seasons are shown more clearly. Very obvious in fig 1 is the widening of the dry season from June-September in Moyale to (April)-May-November in Tunduru. More strikingly still is the gradual disappearance of the dry season (December) -January-February-(March) between Moyale and Tabora while the same period becomes the central part of the rainy season in Tunduru. The rainfall peak of October in Moyale shifts to November in Marsabit, Kitui and Kibwezi, to December in Tabora and to January in Njombe and Tunduru. This shift coincides with the southward movement of the north-east monsoon. The rainfall peak of February in Tunduru shifts to March in Njombe and Tabora and to April in Kibwezi,Kitui,Marsabit and Moyale. This coincides with the northward movement of the south-east monsoon. The northward and southward movement of the monsoonal rainbelts can also be observed when one looks successively at the twelve monthly rainfall maps of East-Africa(EAC,1971, Tomsett,1969)

The Kenya stations (Moyale-Kibwezi) in fig 1 show a bimodal rainfall distribution and the Tanzanian stations (Tabora-Tunduru) show a monomodal distribution.

From Moyale to Tunduru in fig 1 the percentage rainfall in May and Ocober decreases while in December and March it increases. In fig 2 two series of stations, west and east of the Rift Valley respectively but each pair at approximately the same latitude, are compared. The stations East of the Rift Valley, all in Kenya, have a similar pattern though it is worthwhile to note the increasing percentages in March and December and the decreasing percentages in May and October going from north to south.

In the series of stations which are situated West of the Rift Valley a very pronounced change is apparent. The northernmost station (Lodwar) does not seem to fit in the series. No transitional histograms between those for Lodwar and Kitale have been found. The distribution for Lodwar resembes Moyale more than Kitale though the lack of a clear rainy period at the end of the year separates it from Moyale. From Kitale going south the pattern changes from a flat distribution with peaks in April-May and July-August (Kitale,Eldoret, Nakuru) with the driest period in December-February to a rather flat distribution with a peak in March-May and secondary peaks in September and November and a dry period December-February but also July (Kisii). From Kisii going south the dry season in July gradually becomes more pronounced while the dry season December-February becomes part of the rainy season.

Though the stations in fig 2 are arranged in the groups "West" and "East" of the Rift valley it should be mentioned that the Rift valley is only an approximate divide between the two types of distribution. The Kitale-Nakuru distribution type occurs also in the Ol Kalou-Nyandarua-Maralal area on the eastern side of the Rift valley.

The casual factor of the substantial difference in distribution between the area West and East of the Rift valley seems to be the low pressure over Uganda from June to October which brings rain over parts of western Kenya, sometimes as far as Nairobi.

Intermediate distribution types between those found for Nakuru and Embu in fig 2 are occurring as is shown by the data of table 1 which gives the monthly percentages of stations geographically situated in between Nakuru and Embu.

table 1: Monthly rainfall as a percentage of the average annual rainfall for some stations between Nakuru and Embu.

station nr	name												
90.36020	Nakuru	2	4	8	15	13	9	12	12	8	7	7	4
90.36034	Gilgil	3	4	8	15	12	8	9	10	6	8	9	6
90.36024	N.Kinangop For.St.	4	4	8	15	14	9	6	8	9	8	8	5
90.36077	S.Kinangop Foxhangers	4	4	9	19	15	8	5	7	6	7	9	7
90.36106	Kanyenyaine	4	3	6	22	19	5	4	4	4	10	13	7
90.37008	Embu	2	2	9	26	15	3	2	3	2	12	18	5

Fig 3 provides a picture of the rainfall distribution along the main road from Mombasa at the Coast to Tsavo which is 175 km inland. The pattern changes from a nearly unimodal system with the rainfall peak in May (Mombasa) through a bimodal system with the main peak in May and a secondary peak in November (Mariakani) to a bimodal system with the main peak in December and a secondary peak in April. It is remarkable that the peaks shift from April to May and from December to November between Tsavo and Mombasa. This is contrary to the expectation on the basis of the northwards and southwards movement of south-east and north-east monsoons respectively.

On the right hand side of fig 3 the rainfall distribution is given for places close to the Galana river from Malindi to Tsavo which is 175 km upstream. The changes in distribution between those places are essentially the same as between Mombasa and Tsavo.

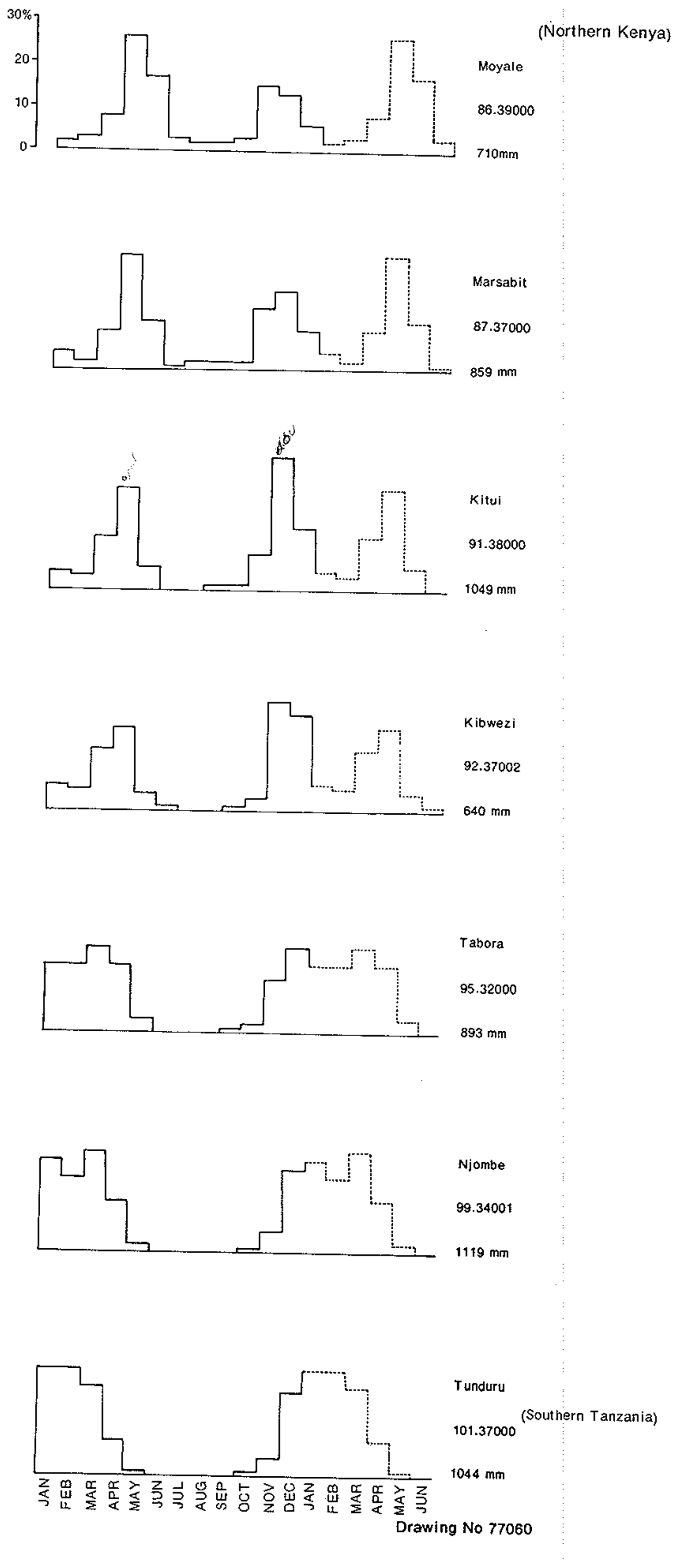
The distance given for each station in fig 3 is the shortest distance to the coast. Fig. 4 provides a picture of the rainfall distribution at different places at the Coast, at stations 15 to 25 km inland and at stations 30 to 45 km inland. From the southcoast (Vanga) to the northcoast (Lamu) the percentage rainfall in the months of March and April decreases while the percentage in May and June increases. The distribution is nearly unimodal with a pronounced rainy season in April, May and June.

Compared with the distribution at the Coast the stations inland and in the hinterland have a more flattened distribution and are also more clearly bimodal than at the coast, though not as pronounced as Tsavo in fig 3 or the stations Moyale to Kibwezi in fig 2.

<u>References</u>

Braun, H.M.H., 1975	Climate in: van de Weg, R.F. and Mbuvi, J.P. eds. Soils of the Kindaruma area. Government Printer, Nairobi
" (in prep.)	Climate in Michieka, D.O., van der Pouw, B.J.A. and Vleeshouwer, J.J. eds. Soils of the Kwale-Mombasa-Lungalunga area. Government Printer, Nairobi, in preparation
EAC, 1971	Mean monthly rainfall maps of East Africa; based on all available data at 1966; scale 1:2,000,000; 12 north and 12 south sheets; East African Community, Nairobi
EAMD, 1974	Summary of rainfall in Kenya for the year 1972; East African Meteorological Department, Nairobi
EAMD, 1973	Summary of rainfall in Tanzania for the year 1973; East African Meteorological Department, Nairobi
Tomsett, J.E., 1969	Average monthly and annual rainfall maps of East Africa; Techn. Memorandum 14, East African Meteorological Department, Nairobi

Fig. 1 Monthly rainfall as a percentage of the annual rainfall for some stations between northern Kenya and southern Tanzania; the first six months of the year are repeated which is indicated by an interrupted line



Drawing No 77060

Fig. 2 Monthly rainfall as a percentage of the annual rainfall for some stations west and east of the Rift Valley, from northern to southern Kenya

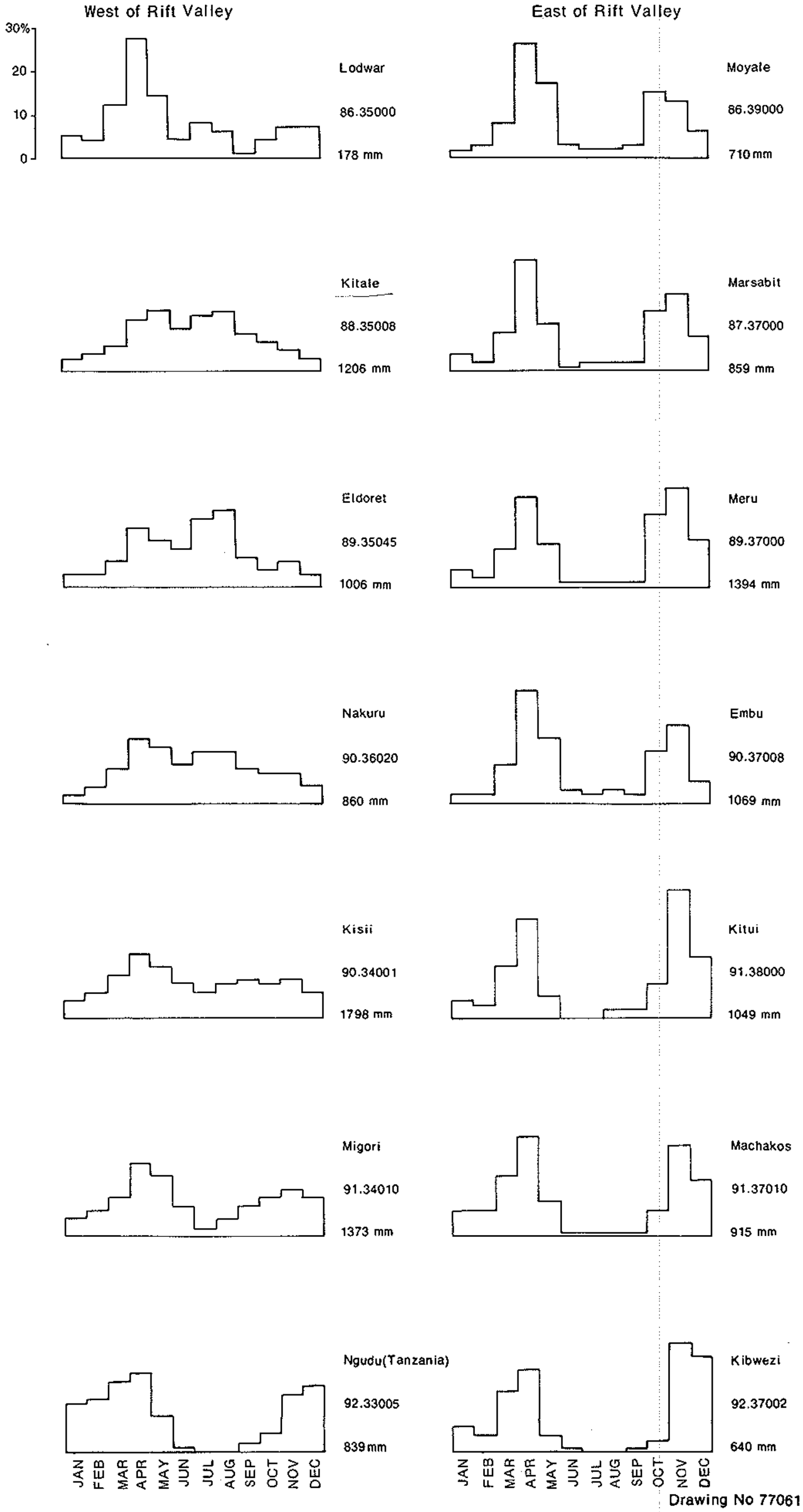
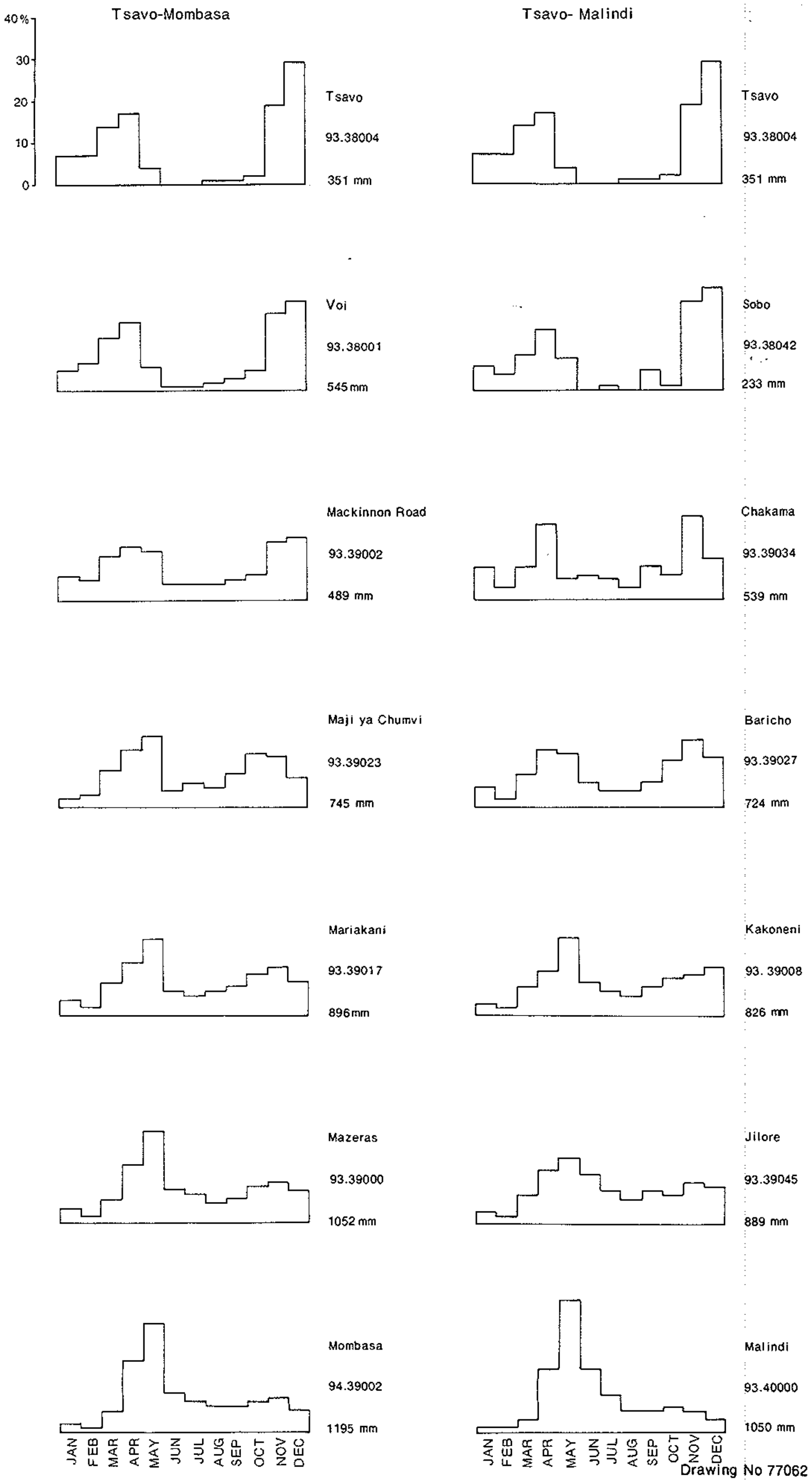


Fig. 3 Monthly rainfall as a percentage of the annual rainfall for some stations along two transects from Tsavo, 175 kilometres inland, to the Kenya coast



Drawing No 77062

Fig. 4 Monthly rainfall as a percentage of the annual rainfall for stations at the Kenya coast and its hinterland