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Seasonal and monthly rainfall probability tables
for the East-central, North-western and Coast region of Kenya

by
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1. Summary

For three areas in Kenya tables are given to estimate the seasonal and monthly rainfall probability if data on average rainfall per season or month are available. The differences between the seasons and between the areas are discussed, while some points of caution for applying the tables for crop production are mentioned.

2. Introduction

While compiling climatic information for the Kindaruma soil survey (Braun,1974, 1975) it became clear that especially for the land evaluation part of that survey, information on seasonal rainfall reliability was required (Luning,1975). In the literature some publications have been found dealing with rainfall probability in East Africa(Manning,1950,1956;Glover and Robinson,1953a,1953b, 1954; Glover et al, 1955; Kenworthy and Glover,1958; Kenworthy,1964; Dowker, 1963; Walker and Rijks,1967; Huxley et al,1969; Lawes,1969 and Brown and Cochemé 1973). None supplied the information required, though some of the publications treat also the subject of seasonal rainfall probability. Most of the papers contain lengthy statistical discussions. Except for some maps at a scale of 1:6,500,000 in Kenworthy and Glover(1958), none of these publications presents any maps, graphs or tables which can be used for the evaluation or estimation of seasonal or monthly rainfall probability.

For estimating the probability that a certain amount of rainfall is exceeded during a season or month, the method of ranking the seasonal or monthly rainfall, as for instance described by Koch(1973), was used. The probability data were plotted against average rainfall and it was found (Braun,1975,1976,in prep.) that the probability of exceeding specific rainfall amounts was well-correlated with average rainfall.

As the relationship between probability and average rainfall is of much significance for assessing agricultural potential or the risk of crop failure and because there are substantial differences in rainfall probability between the three areas, it seemed worthwhile to publish the seasonal rainfall probability tables of the three areas in one report. Some applications of the tables in the form of maps are given by Braun(1975,1976,1977,in prep.)

3. Method

From rainfall data books (EAMD,1974,1966) or from data available at the East African Meteorological Department, Kenya Regional Headquarters, the monthly rainfall data were copied from as many years as possible and for as many stations as data were available in each of the study areas. The stations used in each area are mentioned in the appendix. For each station in the East-central area the rainfall of the months March, April and May (the so-called long rains) and October,November, and December (short rains) was added up for each year.. These seasonal totals for each station were ranked separately for the long and short rains. From such ranked totals per season once can estimate the probability that specified seasonal totals will or will not be exceeded For example, if there are 5 out of 20(25%) March-May seasons with a rainfall less than 100mm, 6 out of 20(30%) with less than 150mm, 9 out of 20(45%) with less than 200mm, 11 out of 20(55) with less than 250mm and 17 out of 20(85%) with less than 300mm and, assuming that there is no change in climate and that the 20-year period is representative, one can conclude that the probability to receive less than 100,150,200,250 and 300mm is 25,30,45,55 and 85% respectively.

The probabilities to receive more than 100,150,200,250, and 300mm will be lower for a station having an average rainfall of 200mm than for a station with an average of 300mm. One might, for example, find that the probabilities to receive more than 100,150,200,250, and 300mm are 75,70,55,45 and 15% respectively for a station with an average of 200mm while the values 100,80,75,55 and 40% are found for a station with an average of 300mm.

The probability to receive more thn 100mm per season was for each station plotted against its average rainfall per season. Through points an S-shaped curve was fitted by eye. Similar S-shaped curves were obtained when the probabilities to receive more than 150,200,250mm etc. were plotted against average seasonal rainfall.

From the set of eye-fitted curves the relevant intervals were read and put in tabular form. This procedure was carried out for the periods March-May (long rains), October-December (short rains) and the monthly rainfall in East-central Kenya, for the periods April-August(rainy season), September-March (dry season), September-December (early dry season), January-March (late dry season) and the monthly rainfall in North-western Kenya and for the periods April-June (long rainy season), July-September (extension rainy season, dry season), October-December (short rainy season) and the monthly rainfall in the Coast region.

4. Results and discussion

In table 1 an example is given of the unranked and ranked three-monthly totals of the rainfall station Tseikuru. Below the ranked tables is given the average (sum divided by 20) and the median (10 seasons with more and 10 seasons with less) rainfall. Noteworthy is that for the March-May period the median is higher than the average which means that at Tseikuru there are more March-May seasons with above-average rainfall than with below-average rainfall. This is exceptional. Generally the median is lower than the average as shown by the October-December period. This means that in general below-average rainfall is occurring more often than above-average rainfall (or in other words: a few seasons with very high rainfall push the average up). At the bottom of table 1 is indicated how the probality values are obtained from the ranked rainfall data.

Fig 1 is an example of the S-shaped curves which are obtained when the probability values of the monthly rainfall are plotted against the average monthly rainfall. Each month is represented by two small dots (25 and 50mm), two big dots (125 and 150mm) and two triangles (250 and 300mm), see for instance at an average rainfall of 315mm.

The relationships between average rainfall and the probability to receive more than specified amounts of rainfall in specified time periods and areas, are given in the tables 2 to 12. At the bottom of each page with tables an example of how to use the tables, is given. In the tables it can be seen that the probability to receive an amount of rainfall which is higher than the average rainfall, is nearly always lower than 50% (there are two values of 50 and one of 51 in tables 5 and 6) and is sometimes as low as 32. (table 4). This means, as has been remarked above, that there are more seasons or months with below-average rainfall than there are with above-average rainfall.

Separate tables of rainfall probability have been given for seasonal rainfall and monthly rainfall, since it was found that the seasonal rainfall probability distribution is different from the monthly rainfall probability distribution (compare for instance tables 2 and 4). It is empasized also that the dependable (=75% probability to be exceeded) seasonal rainfall cannot be estimated by adding up the dependable rainfall of the months of the season. Thus one should not add up the dependable rainfall for March, April and May to estimate the dependable rainfall for the March-May season. There appears however, to be a linear relationship between the two. For 7 stations with a total of 14 seasons in East-central Kenya it was found that the seasonal dependable (=75% probability) rainfall (Y) is related to the sum of the dependable rainfall of the months of the season, (sum X). The approximate equation Y = 1.20 x sum X + 25 is valid for sum X(in mm) between 100 and 450. Similarly it was found for 7 stations in East-central and 12 stations in North-western Kenya that the annual dependable rainfall (Z) is related to the sum-of the monthly dependable rainfall (sum X). The approximate equation Y = 1.18 x sum X + 220 is valid for sum X (in mm) between 250 and 1200.

For East-central Kenya separate rainfall probability tables have been given for the March-May period (long rains; triable 2) and the October-December period (short rains; table 3), because it appears that the probability distribution in the long and short rains is different (see table 13 which is an amalgamation of tables 2 and 3). In the top left corner of table 13 the probabilities are higher for the short than for the long rains while in the rest of the table the probabilities are higher for the long rains than for the short rains. The practiotical significance is that for low rainfall averages the short rains are more reliable than the long rains. For averages of 400mm and higher all the probability percentages in tables 13 are higher for the long rains than for the short rains. On theoretical grounds it can be argued that somewhere in each row the percentages for he long rains should be lower than for the short rains and this is likely to occur in the "tail" above receiving amounts higher than 500mm which is not shown in table 13. This phenomenon is demonstrated in table 14 which is compiled from tables 5 and 6: left of the stepped line the probability values are higher for the period April-August while right of the line September - March shows the highest values. Also in table 15 which is a combination of data from tables 9, 10 and 11 it can be seen that the probability distribution of the rainfall is different in each of the seasons.

That the rainfall probability distributions for the East-central, North-western and Coast region are different is probably best demonstrated by table 16 which is a combination of the data given in tables 4,8 and 12. Table 16 shows that the North-western region has the highest probability of receiving rainfall amounts up to the average rainfall (e.g. 38% compared with 32 and 34% for 25mm average; 95,86,64 and 44% compared with 86,67,53,41 and 92,74,56,41% for 100mm average) and generally has the lowest probability for receiving rainfall amounts above the average rainfall. The differences in rainfall probability between the Coast and the East-central region are generally small. They vary for different average rainfall amounts and expected rainfall amounts.

When applying the data given in the tables it should be realised that apart from a variation of plus or minus five percent (see fig 1) two other aspects should be taken into account if the amount of rainfall needed for crop production is considered. Firstly, it has to be empasized that generally some rainwater is lost for crop production through surface runoff. Secondly, it has to be realised that because of the concentration of the rainfall at the beginning of the rainy season,-in East-central Kenya 50% of the three-monthly rainfall comes in the first 22 days (Braun,1975),-generally part of the rainfall is unavailable for plant growth because it infiltrates beyond the rooting zone of seasonal crops. The proportion of the rainfall which is unavailable depends on the distribution of the rainfall, the water holding capacity and depth of the soil, and the rooting depth and root density of the crop. From the above it will be clear that the amount of rainfall needed for proper crop growth is generally larger than the evaporative demand of the crop. It is not possible to give a general quantitative rule indicating how much more rainfall is needed.

An extensive example is given below to show the use of the tables.

Example:

A crop with a growing period of 90 days and a water requirement of 300mm in the short rains and 320mm in the long rains is to be grown in a locality in Machakos district with an average rainfall of 270mm in the long rains and 350mm in the short rains (e.g. Kampi ya Mawe).

What is the probability to receive enough rainfall for the crop assuming that there is no surface or sub-surface runoff?

long rains: table 2; average rainfall 270mm, required rainfall 300mm;
interpolate between 28 and 44 = 34% (or once per 3 seasons)
short rains: table 3; average rainfall 350mm, required rainfall 320mm;
interpolate between 55 and 40 = 49% (or once per 2 seasons)

What is the probability to receive enough rainfall for the crop assuming that there is 25mm surface runoff and 25mm sub-surface runoff?

long rains: table 2; average rainfall 270mm, required rainfall 300+25+25+350mm; interpolate between 18 and 31=24%

short rains: table 3; average rainfall 350mm, required rainfall 320+25+25=370mm; interpolate between 40 and 29 =36%

What is the probability of a crop water deficit of at least 100mm, assuming that there is 25mm surface runoff and 25mm sub-surface runoff?

long rains: table 2; average rainfall 270mm, required 300-100+25+25=250mm; interpolate between 42 and 59 =49% ; 100-49=51%

short rains: table 3; average rainfall 350mm, required rainfall 320-100+25+25 =270mm; interpolate between 69 and 55=63%; 100-63= 37%

What is the probability to receive enough water for the crop if the growing period is 115 days; the water requirement 350mm and 375mm; the average rainfall over $3\frac{1}{2}$ months 275mm, for the long rains and 370mm for the short rains; surface runoff 25mm, surface runoff 25mm?

long rains: table 2; average rainfall 275mm, required rainfall 350+25+25=400mm; interpolate between 12 and 21 =17% short rains: table 3; average rainfall 370mm, required rainfall 375=25=25= 425mm; interpolate between 29 and 20=24.5%, interpolate between 38 and 29 =33.5%; interpolate between 24.5 and 33.5 =29%

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Fig. 1 Rainfall expectation (in%) in relation to average monthly rainfall for East-Central Kenya

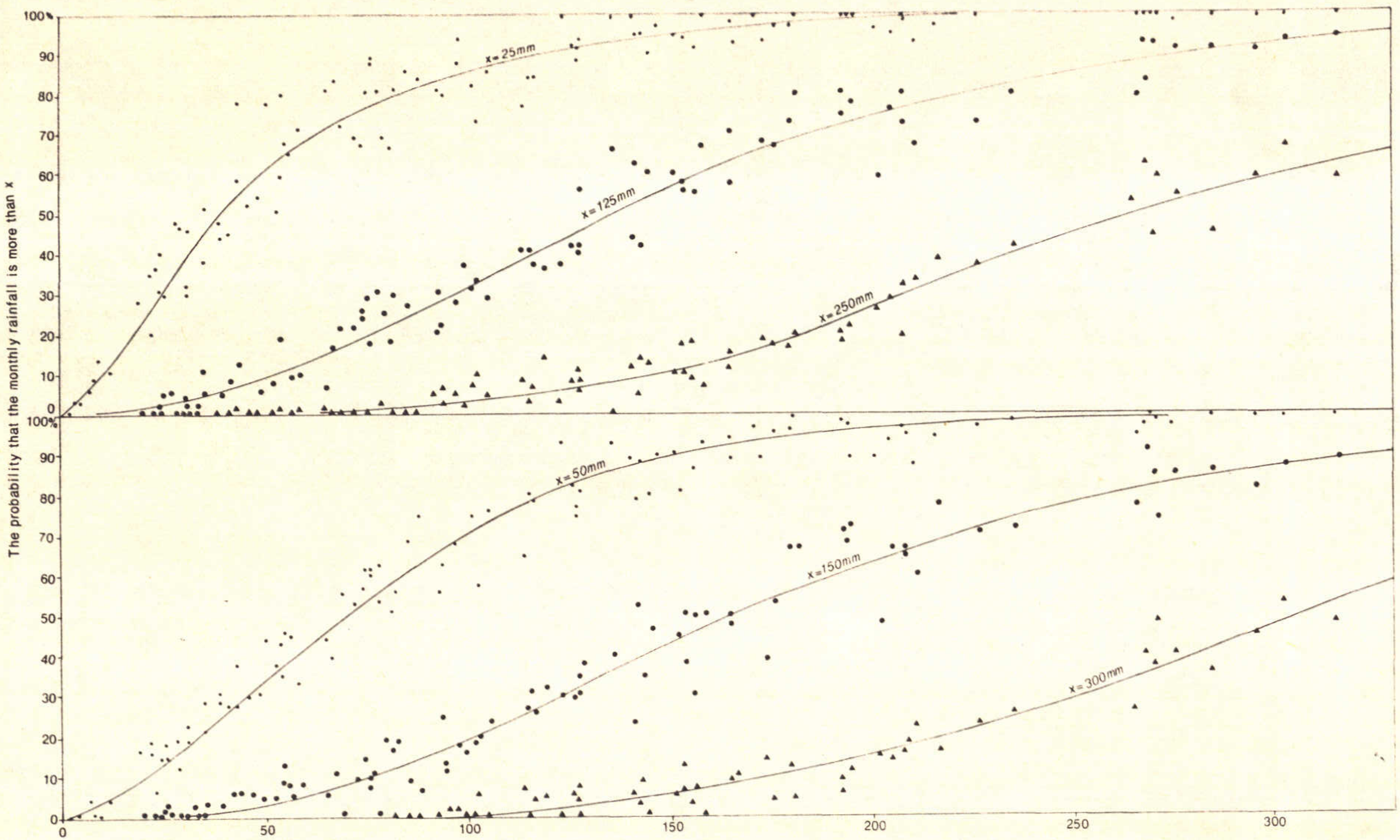

Table 1: The seasonal rainfall (in mm.) at Tseikuru (90.38004) from 1951 to 1972 (1960 and 1970 are missing)

			Ranked		
	March-May	Oct-Dec	March-May	No.	Oct-Dec
1951	379	523	7	1	121
1952	82	121	42	2	137
1953	7	138	46	3	138
1954	184	165	60	4	145
1955	170	315	82	5	165
1956	180	259	101	6	206
1957	294	357	170	7	219
1958	277	228	180	8	228
1959	218	137	184	9	288
1961	60	958	218	10	259
1962	264	291	228	11	276
1963	271	544	264	12	291
1964	228	330	271	13	315
1965	46	219	276	14	330
1966	412	145	277	15	357
1967	287	506	287	16	506
1968	411	573	294	17	523
1969	276	206	379	18	544
1971	101	228	411	19	573
1972	42	276	412	20	958
Average	209	326	209		326
Median			223		267

March-May; the probability to receive more than

50	100	150	200	250	300	350	400mm
17:20	15:20	14:20	11:20	9:20	3:20	3:20	2:20
85%	75%	70%	55%	45%	15%	15%	10%

October-December; the probability to receive more than

50	100	150	200	250	300	350	400mm
20:20	20:20	16:20	15:20	11:20	8:20	6:20	5:20
100%	100%	80%	75	55%	40%	30%	25%

Table 2: Rainfall expectation (in %) in relation to the average rainfall for the period MARCH-MAY (long rains) in Meru, Embu, Machakos and Kitui districts (i.e. the area south of the equator till 2°20 South and from 37°East till 38°40.E).

average rainfall	the probability to receive more than 100	150	200	250	300 is	350	400	450	500mm
200mm	74%	54	38	23	15	9	5	2	0
250	86	70	56	42	28	18	12	7	3
300	93	83	72	59	44	31	21	14	8
350	98	92	85	74	59	44	31	23	15
400	100	97	92	84	72	58	43	33	23
450	100	99	96	89	82	69	57	43	34
500	100	100	98	92	87	80	68	56	44
550	100	100	99	95	91	86	78	69	56
600	100	100	100	97	93	91	85	80	69
650	100	100	100	99	97	95	92	89	80

Table 3: Rainfall expectation (in %) in relation to the average rainfall for the period OCTOBER-DECEMBER (short rains) in Meru, Embu, Machakos and Kitui districts (i.e. the area south of the equator till 2°30's and from 37°E and 38°40'E).

average rainfall	the probability to receive more than 100	150	200	250	300 is	350	400	450	500mm
100mm	45%	18	5	1	0				
150	80	46	23	10	4	1	0		
200	89	70	44	27	11	7	4	1	0
250	94	83	62	43	25	16	11	5	1
300	96	90	74	58	39	27	19	12	5
350	99	93	83	69	55	40	29	20	11
400	100	96	88	78	66	52	38	29	19
450	100	98	91	85	78	65	50	38	28
500	100	99	93	89	83	74	62	49	39
550	100	100	95	92	88	81	71	59	49
600	100	100	97	95	91	85	78	68	58

Example: See top of next page.

Example: for a locality with an average March-May rainfall of 500mm the probability to receive 350mm or more rainfall during the period March-May is 80%; for a locality with an average October-December rainfall of 450mm the probability to receive more than 450mm during the October-December period is 50% (or 8/10 and 5/10 seasons resp.)

Table 4: Rainfall expectation (in %) in relation to the average rainfall per MONTH in Meru, Machakos and Kitui districts (i.e. the area south of the equator till 2°30' South and from 37°East till 38°40' East).

average rainfall.	the probability to receive more than 25	50	75	100	125 is	150	175	200	250	300mm
25mm	32%	15	7	3	1	0				
50	61	35	20	12	8	5	2	2	0	
75	77	53	36	25	18	12	6	2	0	
100	86	67	53	41	30	20	13	7	2	0
125	92	78	66	55	42	30	21	14	7	2
150	96	86	77	67	55	41	30	21	12	6
175	99	92	85	76	66	53	41	29	19	11
200	100	96	91	83	74	64	52	38	27	16
225		100	95	88	80	72	61	48	35	22
250		100	97	92	85	78	69	58	45	28
275		100	99	95	89	83	76	66	53	35
300			100	97	93	88	82	72	59	42

Example: the average rainfall during the month of April at Embu is 275mm; then the probability to receive more than 50mm in April is 100%, more than 100mm 95%, more than 150mm 83%, more than 200mm 66% and more than 300mm 35% (which is equivalent to 20 per 20, 19 per 20, approximately 17 per 20, 13 per 20, and 7 per 20 April months re pectively).

Table 5: Rainfall expectation (in %) in relation to the average rainfall for the period APRIL-AUGUST in North-western Kenya (i.e. the area formed by the triangle Nakuru-Busia-Lodwar), especially Trans-Nzoia and West Pokot districts

the probability to receive more than

average rainfall	200	300	400	500	600	700	800	900	1000 mm
					is				
100mm	8%	2	0						
200	47	16	3	0					
300	85	49	15	3	0				
400	99	82	42	17	6	2	0		
500	100	96	78	39	20	10	1	0	
600	100	99	95	71	42	23	10	2	0
700		100	99	91	72	46	25	10	2
800			100	99	91	75	48	26	11
900				100	99	92	73	50	29
1000					100	99	89	73	51

Table 6: Rainfall expectation (in .) in relation to the average rainfall for the period SEPTEMBER-MARCH in north-western Kenya (i.e. the area formed by the triangle Nakuru-Busia-Lodwar), especially Trans-Nzoia and West Pokot districts

the probability to receive more than

average. rainfall.	50	100	150	200	250	300	400	500	600	700	800
						is					
200mm	94	81	63	45	28	18	3	0			
250	99	91	79	63	43	30	9	0			
300	100	97	91	78	60	44	19	4	0		
350	100	99	97	90	75	60	32	11	2	0	
400	100	100	100	96	87	76	47	22	8	2	0
500				100	99	95	74	47	28	14	3
600					100	100	90	68	48	31	14
700						100	99	83	65	50	32

Example: the average rainfall during the period APRIL-AUGUST at Kitale is 700mm; then the probability to receive more than 400mm is 99%, more than 500mm 91%. more than 600mm 72%, more than 700mm 46% and so on.

Table 7: Rainfall expectation (in %) in relation to the average rainfall during the periods JANUARY-MARCH or SEPTEMBER-DECEMBER in north-western Kenya (i.e. the area formed by the triangle Nakuru-Busia-Lodwar), especially Trans Nzoia and West Pokot districts

the probability to receive more than

average. rainfall.	50	100	150	200	250 is	300	350	400mm
50mm	40%	20	9	4	1	0		
100	70	45	25	13	6	1	0	
150	86	67	46	28	15	6	1	0
200	95	82	66	49	30	15	6	0
250	99	91	82	67	49	29	15	8
300	100	96	91	82	66	47	30	15
350	100	98	96	91	80	64	47	30
400		100	99	96	89	78	64	47
450			100	98	95	88	80	64
500				100	98	94	87	76

Table 8: Rainfall expectation (in %) in relation to the average rainfall per MONTH in north-western Kenya (i.e. the area formed by the triangle Nakuru-Busia-Lodwar), especially Trans Nzoia and West Pokot districts

the probability to receive more than

average. rainfall.	25	50	75	100	125 is	150	200	250mm
25 mm	38%	15	6	2	1	0		
50	70	40	20	12	5	1	0	
75	84	66	42	26	15	8	2	0
100	95	86	64	44	28	17	5	2
125	98	94	81	63	44	30	10	4
150	100	98	92	81	63	45	18	7
175		100	96	91	80	63	29	12
200		100	98	96	90	78	44	21
250			100	100	99	98	75	45

Example: the average rainfall during the month of August at Kitale is 150mm; then the probability to receive more than 25mm is 100%, more than 50mm 98%, more than 75mm 92% and more than 150mm 45%(which is equivalent to 50 per 50,49 per 50,46 per 50 and 9 per 20 August months respectively).

Table 9: Rainfall expectation (in %) in relation to the average rainfall for the period APRIL-JUNE at the Kenya Coast and its Hinterland, especially Kwale district.

for average rainfall is	the probability to receive more than 100	150	200	250	300	350	400	450	500	600	700	800	900	1000mm
200mm	95%	66	49	33	20	9	2	0						
250	93	78	62	47	33	21	9	3	1	0				
300	96	85	71	60	45	33	20	11	6	2	0			
350	98	90	79	69	54	42	30	19	12	4	1	0		
400	100	94	85	76	65	53	40	29	21	11	3	0		
450	100	97	89	82	74	64	53	40	30	20	9	1	0	
500	100	99	93	87	81	74	64	52	41	29	15	2	0	
550		100	95	91	87	81	73	63	52	40	23	7	1	0
600		100	98	95	91	86	81	73	63	50	31	13	2	0
650			100	98	95	91	86	80	72	60	39	20	7	2
700				100	99	95	91	85	78	67	47	28	16	7
750					100	99	95	91	84	75	57	38	25	16
800						100	99	95	90	82	67	48	37	25
850							100	99	95	87	78	60	49	37

Table 10: Rainfall expectation (in %) in relation to the average rainfall for the period OCTOBER-DECEMBER at the Kenya Coast and its Hinterland, especially Kwale district.

for average rainfall is	the probability to receive more than 25	50	75	100	150	200	250	300	350	400	450	500	550	600mm
125mm	85	71	58	46	32	24	16	10	6	4	1	0		
150	91	78	67	57	42	32	22	16	12	8	5	2	0	
175	96	85	76	66	50	39	27	21	16	10	6	3	1	0
200	98	91	82	76	59	47	33	24	19	12	7	4	2	0
225	100	96	90	85	67	53	38	28	21	15	9	5	2	0
250	100	99	96	91	75	58	42	32	23	16	11	6	3	1
275		100	98	94	82	63	47	34	25	18	12	7	4	2
300		100	99	96	85	67	50	37	28	19	13	8	4	2

Example: the average rainfall during the period APRIL-JUNE at Ndavaya is 300mm; then the probability to receive more than 100mm is 96%, more than 250mm 60% and more than 600mm 2% (which is equivalent to 24 per 25, 3 per 5 and once per 50 APRIL-JUNE seasons at at Ndavaya respectively).

Table 11: Rainfall expectation (in %) in relation to the average rainfall for the periods JANUARY - MARCH or JULY-SEPTEMBER at the Kenya Coast and its Hinterland, especially Kwale district

average. rainfall.	the probability to receive more than								
	25	50	75	100	150	200	250	300	350mm
					is				
25mm	29%	15	6	1	0				
50	62	42	22	9	0				
75	80	62	42	22	8	2	0		
100	90	76	58	38	18	6	0		
125	95	87	71	54	30	12	5	1	0
150	98	95	82	68	42	18	10	3	0
200	100	99	95	85	61	34	21	11	5
250		100	100	95	76	55	35	24	7

Table 12: Rainfall expectation (in %) in relation to the average rainfall per MONTH at the Kenya Coast and its Hinterland, especially Kwale district

average. rainfall.	the probability to receive more than										
	25	50	75	100	125	150	200	250	300	400	500mm
					is						
25mm	34%	18	9	5	2	1	0				
50	60	38	21	12	6	3	1	0			
75	82	60	40	25	15	9	4	1	0		
100	92	74	56	41	27	19	9	4	2	0	
125	95	84	69	53	41	29	18	10	5	2	0
150	97	89	77	62	51	39	25	16	9	5	1
200	99	95	88	77	66	55	43	30	20	12	5
250	100	98	94	88	79	70	58	45	33	19	7
300	100	99	97	95	88	81	70	58	46	28	11
400		100	100	99	97	94	90	79	69	41	23

Example: the average rainfall during the month of July at Vaa is 75mm; then the probability to receive more than 25mm is 82%, more than 50mm 60%, more than 75mm 40% (which is equivalent to 4 out of 5,3 out of 5 and 2 out of July months respectively).

Table 13: Rainfall expectation (in %) for the LONG and SHORT rains in East-central Kenya

the probability to receive more than

for aver. rainfall of	100	150	200	250	300 is	350	400	450	500 mm
200mm long	74	54	38	23	15	9	5	2	0
200mm short	89	70	44	27	11	7	4	1	0
250mm long	86	70	56	42	28	18	12	7	3
250mm short	94	83	62	43	25	16	11	5	1
300mm long	93	83	72	59	44	31	21	14	8
300mm short	96	90	74	58	39	27	19	12	5
350mm long	98	92	85	74	59	44	31	23	15
350mm short	99	93	83	69	55	40	29	20	11
400mm long	100	97	92	84	72	58	43	33	23
400mm short	100	96	88	78	66	62	38	29	19
450mm long	100	99	96	89	82	69	57	43	34
450mm short	100	98	91	85	78	65	50	38	28
500mm long		100	98	92	87	80	68	56	44
500mm short	100	99	93	89	83	74	62	49	39
550mm long		100	99	95	91	86	78	69	56
550mm short		100	95	92	88	81	71	59	49
600mm long			100	97	93	91	85	80	69
600mm short		100	97	95	91	85	78	68	58

Table 14: Rainfall expectation (in %) for the period APRIL-AUGUST (rainy season) and the period SEPTEMBER-MARCH (dry season) in North-western Kenya.

th

the probability to receive more than

for aver. rainfall of	200	300	400	500 is	600	700	800mm
200mm Apr-Aug	47	16	3	0			
200mm Sep-Mar	45	18	3	0			
300mm Apr-Aug	85	49	15	3	0		
300mm Sep-Mar	78	44	19	4	0		
400mm Apr-Aug	99	82	42	17	6	2	0
400mm Sep-Mar	96	76	47	22	8	2	0
500mm Apr-Aug	100	96	78	39	20	10	1
500mm Sep-Mar	100	95	74	47	28	14	3
600mm Apr-Aug	100	99	95	71	42	23	10
600mm Sep-Mar		100	90	68	48	31	14
700mm Apr-Aug		100	99	91	72	46	25
700mm Sep-Mar		100	99	83	65	50	32

Table 15: Rainfall expectation (in %) for the periods APRIL-JUNE, OCTOBER-DECEMBER, &JULY-SEPTEMBER at the Kenya Coast.

for average rainfall of	the probability to receive more than 100	150	200	250	300	350	400mm
	is						
200mm Apr-Jun	88	66	49	33	20	9	2
200mm Oct-Dec	76	59	47	33	24	19	12
200mm Jul-Sep	85	61	34	21	11	5	-
250mm Apr-Jun	93	78	62	47	33	21	9
250mm Oct-Dec	91	75	58	42	32	23	16
250mm Jul-Sep	95	76	55	35	24	7	-
300mm Apr-Jun	96	85	71	60	45	33	-
300mm Oct-Dec	96	85	67	50	37	28	-
300mm Jul-Sep	-	-	-	-	-	-	-

Table16: Rainfall expectation (in %) per MONTH for the East-central, North-western and Coast region of Kenya

for average rainfall of	the probability to receive more than 25	50	75	100	125	150	200	250	300mm
					is				
25mm East-C	32	15	7	7	1	0			
25mm North-W	38	15	6	2	1	0			
25mm Coast	34	18	9	5	2	1	0		
50mm East-C	61	35	20	12	8	5	0		
50mm North-W	70	40	20	12	5	1	0		
50mm Coast	60	38	21	12	6	3	1	0	
75mm East-C	77	53	36	25	18	12	2	0	
75mm North-W	84	66	42	26	15	8	2	0	
75mm Coast	82	60	40	25	15	9	4	1	0
100mm East-C	86	67	53	41	30	20	7	2	0
100mm North-W	98	86	64	44	28	17	5	2	-
100mm Coast	92	74	56	41	27	19	9	4	2
125mm East-C	92	78	66	55	42	30	14	7	2
125mm North-W	98	94	81	63	44	30	10	4	-
125mm Coast	95	84	69	53	41	29	18	10	5
150mm East-C	96	86	77	67	55	41	21	12	6
150mm North-W	100	98	92	81	63	45	18	7	-
150mm Coast	97	89	77	62	51	39	25	16	9
200mm East-C	100	96	91	83	74	64	38	27	16
200mm North-W	100	100	98	96	90	78	44	21	-
200mm Coast	99	95	88	77	66	55	43	30	20
250mm East-C	100	100	97	92	85	78	58	45	28
250mm North-W	100	100	100	100	99	98	75	45	-
250mm Coast	100	98	94	88	79	70	58	45	33
300mm East-C	100	100	100	97	93	88	72	59	42
300mm North-W	-	-	-	-	-	-	-	-	-
300mm Coast	100	99	97	95	88	81	70	58	46

Appendix: Glossary of the stations whose rainfall data have been used

A1 Seasonal rainfall East-central Kenya

89.37000	Moru	1931-1960	91.37021	Okia	1931-1959
90.37002	Tumu tumu	1931-1960	28	Matiliku	1936-1972
7	Murang'a	1931-1960	32	Kasikou	1943-1971
8	Embu	1908-1972	40	Matungulu	1941-1972
16	Mitubiri	1933-1972	45	Iveti	1942-1971
28	Makuyu	1931-1972	53	Mitubiri	1938-1972
37	Tana Power Station	1932-1972	71	Makaveti	1951-1972
39	Kiritiri	1940-1972	73	Ulu	1936-1960
53	Kevote	1945-1972	74	Kithimani	1952-1971
72	Rombia	1949-1970	75	Kampi ya Mawe	1953-1972
103	Morinduko	1955-1972	76	Yatta B2	1953-1972
104	Machanga	1958-1971	78	Mbooni	1956-1972
110	Tebere	1955-1971	91.38000	Kitui	1904-1971
112	Mwea	1955-1972	1	Mutono	1942-1972
90.38000	Katze	1941-1972	2	Mulango	1946-1970
2	Muvokoni	1946-1972	3	Kitui	1946-1972
3	Mwingi	1954-1972	4	Zombe	1940-1970
4	Tseikuru	1951-1972	5	Migwani	1942-1972
5	Ngomeni	1954-1971	6	Kanziko	1942-1972
91.37001	Konza	1931-1960	7	Voo	1942-1972
3	Kilima Kiu	1914-1972	8	Mui	1942-1972
8	Kamuthanga	1931-1960	10	Mutha	1950-1971
10	Machakos	1894-1972	11	Ndau	1951-1972
12	Kiu	1931-1960	92.37000	Makindu	1931-1960
13	Chania Est.	1931-1960	2	Kibwezi	1931-1960
14	Potha Est.	1921-1972	3	Simba	1931-1960
20	Kangundo	1932-1972			

A2 Monthly rainfall East-central Kenya

89.37000	Meru	(only March, April, May, October, November, December)
90.37007	Muranga	(only May, November)
8	Embu	
39	Kiritiri	
53	Kevote	
72	Rombia	(only March, April, May, October, November, December)
90.38000	Katze	(only April, November, December)
3	Mwingi	(only April, November)
8	Kamuthanga	(only April, November)
10	Machakos	
13	Chania Est.	(only April, November
18	Thika	(only November)
74	Kithimani	
76	Yatta B2	
89	Katumani	
91.38000	Kitui	

Appendix: Glossary of stations whose rainfall data have been used

B1 Seasonal rainfall North-western Kenya

all data from 1931-1960

86. 35000	Lodwar
88.34009	Endebess
88.35004	Kapenguria
5	Kipkoitet
8	Kitale
89.34001	Kakamega
12	Turbo
13	Mumias
89.34005	Moi's Bridge
14	Tambach
18	Kapsabet
20	Kabarnet
41	Eldoret
89.36049	Rumuruti
90.36020	Nakuru

B2 Monthly rainfall North-western Kenya

88.34009	Endebess	
88.35004	Kapenguria	
5	Kipkoitet	
8	Kitale	
89.35005	Moi's Bridge	
89.34001	Kakamega	(only April, May, August)
12	Turbo	(only August)
13	Mumias	(only April, May)
89.35018	Kapsabet	(only April, May)
20	Kabarnet	(only July, August)

Appendix: Glossary of stations whose rainfall data were used

C 1 Seasonal rainfall Kenya Coast

92.40000	Kipini	1931-1968
1	Lamu	1931-1972
3	Witu	1930-1972
93.39000	Mazeras	1930-1969
4	Kilifi	1930-1972
6	Samburu	1936-1975
49	Makamini	1953-1975
93.40000	Malindi	1930-1972
94.39001	Kwale	1931-1975
2	Mombasa	1931-1975
3	Ramisi	1931-1975
4	Gazi	1931-1975
13	Vanga	1943-1972
14	Msambweni	1943-1972
15	Kinango	1948-1975
17	Tiwi	1945-1975
21	Mombasa A.P	1946-1975
25	Kinango pump	1948-1975
27	Mwangulu	1949-1975
28	Ndavaya	1949-1975
30	Muhaka	1950-1975
31	Mrere	1949-1975
38	Waa	1953-1975
43	Shimba	1953-1975
44	Kikoneni	1956-1975
46	Lungalunga	1955-1975

C 2 Monthly rainfall Kenya Coast

92.40000	Kipini
1	Lamu
93.39000	Mazeras
94.39001	Kwale
2	Mombasa
3	Ramisi
4	Gazi