Miscellaneous Paper No. 8

Agro-climatic zones of the parish of Manchester, Jamaica

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SUMMARY

Precipitation data recorded at 17 locations in the parish of Manchester, Jamaica, are statistically analyzed with a view to characterizing the variability of monthly and annual rainfall totals in space and time. Median annual precipitation ranges from about 800 mm in the southern coastal strip to over 2050 mm in the northern mountain range. Mean annual potential evapotranspiration decreases from about 1600 to 1250 mm in the same general direction. A fairly wide range of "moisture availability" zones occur as a result. The dependable growing period (75% level of statistical probability) extends from the middle of September to November in the dry coastal strip and from April to December in the north-eastern part of the parish. Mean daily air temperature ranges from 26 to 20 degrees Celsius due to the marked range in elevation (about 0-1000m above mean sea level). The observed pattern of monthly rainfall, potential evapotranspiration and air temperature is depicted on an agro-climatic zones map at a scale of 1:250,000. A wide range of climatically adapted crops can be grown under rainfed conditions in Manchester, except in the coastal strip where irrigated uses are recommended.

Key words: agro-climatic zoning, 75%-dependable growing period, Manchester, Jamaica

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1. INTRODUCTION

The climatic, topographical, soil and socio-economic conditions in a country determine to a great extent which crop assortment can be grown commercially. A good understanding of the relationships between the above factors forms the basis for sound agro-economic planning.

Jamaica has a fairly good soil data base (RRC 1958-1970), according to Smith (1975), and good climatic data (see JMS 1973). Yet this information has not always been used optimally to address important agricultural problems. This shortcoming has been recognized by various organizations in Jamaica (e.g. IICA 1982), inclusive of the Rural Physical Planning Division which is in the process of updating the soil data base for the island and implementing a Geographical Information System (JAMGIS) for rural planning.

Agro-climatic conditions in the parish of Manchester, Jamaica, are analyzed in this paper mainly with a view to characterizing the regional rainfall pattern for agricultural planning purposes. Similar studies were prepared for the parishes of St. Catherine (SSU 1987) and Clarendon (SSU 1988b). Upon completion of additional studies for the remaining 10 parishes an agro-climatic zones can be prepared for the Islandwide. This source of information may then serve as the basis for crop zoning excercises, at a scale of 1:100,000 to 1:250,000, using JAMGIS.

The soils of Manchester were first mapped by staff of the Regional Research Centre (Stark 1964). Soil Survey Unit staff subsequently undertook the task of updating the soil data base for the northern part of the parish (SSU, in preparation). The present agro-climatic study was prepared within the wider operational framework of the above activities.

Chapter 2 explains how the "raw" climatic data sets, as obtained from the Jamaican Meteorological Office (JMS), have been analyzed using the computer. Chapter 3 defines the concepts of rainy season and dependable growing period. Results of the statistical analyses of monthly and annual rainfall totals are discussed in Chapter 4. Finally, the parish of Manchester is divided into agro-climatic zones on the basis of the observed pattern of rainfall, potential evapo-transpiration and air temperature (Chapter 5).

2. MATERIALS AND METHODS

2.1 Precipitation

There are over 400 rainfall recording stations in the island of which at least 130 have continuous and good quality data for over 30 years (see JMS 1973). For the purpose of this study the Rural Physical Planning Division (RPPD) obtained the following data sets of monthly precipitation for Manchester:

a) Photocopies of typed monthly rainfall totals recorded during the period 1901-1968.

b) Computer listings of monthly rainfall data for 1969-1977 (from the magnetic tape available at the National Computer Centre).

c) Photocopies of manuscript records of monthly precipitation for 1951-1980.

Prior to preparing the computerized climatic data files the author checked the available records for eventual inconsistencies. Overlapping records for the period 1951-1968 in sources a and c matched perfectly, but this was not always the case for the period 1969-1977 (b and c). Additional checks indicated that there are two types of errors in source b, viz.:

- data entry errors for monthly periods and hence yearly totals

- wrongly computed totals for annual rainfall because "missing values" were processed as "zero rainfall" data.

Data from source b were not used in this study. As a result, it was not feasible to "merge" the rainfall records for the period 1901-1968 and 1969-1977 into one computerized data file. The initial aim of using 1951-1977/80 as the reference period for all recording stations could not be met as a result, also in view of the occurrence of missing values.

A search of the remaining sources (a and c) yielded good data sets, i.e. with at least 20 years of continuous observations, for 13 stations. They are: Alligator Pond, Christiana, Craig Head, Hartham, Kendal, Green Vale, Grove Plave, Gut River, Mandeville, Marshall's Pen, Mile Gully, New Port and Porus. Four stations with somewhat shorter data records are also included in this study so as to obtain a better coverage. They are: Manchester Pastures (16-17 observations per month), Spur Tree H.E. (14-17), Tregaron (17-19) and Williamsfield (16-20). The above recording stations are fairly evenly distributed over the parish (Figure 1).

Statistical analyses of monthly and yearly rainfall totals at the above 17 stations were carried out with the Jamaica Physical Land Evaluation System (Batjes and Bouwman 1989, SSU 1989b). The statistical procedure includes an algorithm for smoothening, i.e.

normalizing, originally skewed rainfall data series so as to permit the use of statistical testing procedures based on the assumption of normality (SSU 1986).

Mean annual rainfall data for an additional 23 stations, in part located in the surrounding parishes, have been used when compiling the agro-climatic zones map for Manchester (see Appendix II). This was done in order to obtain a higher density of observation points, thereby facilitating map correlation with the surrounding parishes.

2.1 Monthly potential evapo-transpiration

IICA (1983) developed linear regression functions which relate monthly potential evapo-transpiration, calculated according to Priestley-Taylor's formula (PET), with elevation above mean sea level. According to the author's knowledge, this is the only widely applicable method for calculating PET on an islandwide basis to date.

The use of a different calculation procedure, for instance the methods of Hargreaves or Penman, would have generated somewhat different values for PET. The order of magnitude of these diffences is +/- 10 percent in the case of New Monymusk in the parish of Clarendon (see SSU 1988b p.7). This level of accuracy is considered acceptable in regional studies of crop water requirements in Jamaica (SIRI 1987).

2.3 Air temperature

Monthly fluctuations in daily air temperature are calculated using linear regression functions of air temperature against elevation above mean sea level (see Appendix I). Mean air temperature decreases by about 0.5 degrees Celsius per 100 meter rise in elevation (SSU 1988a).

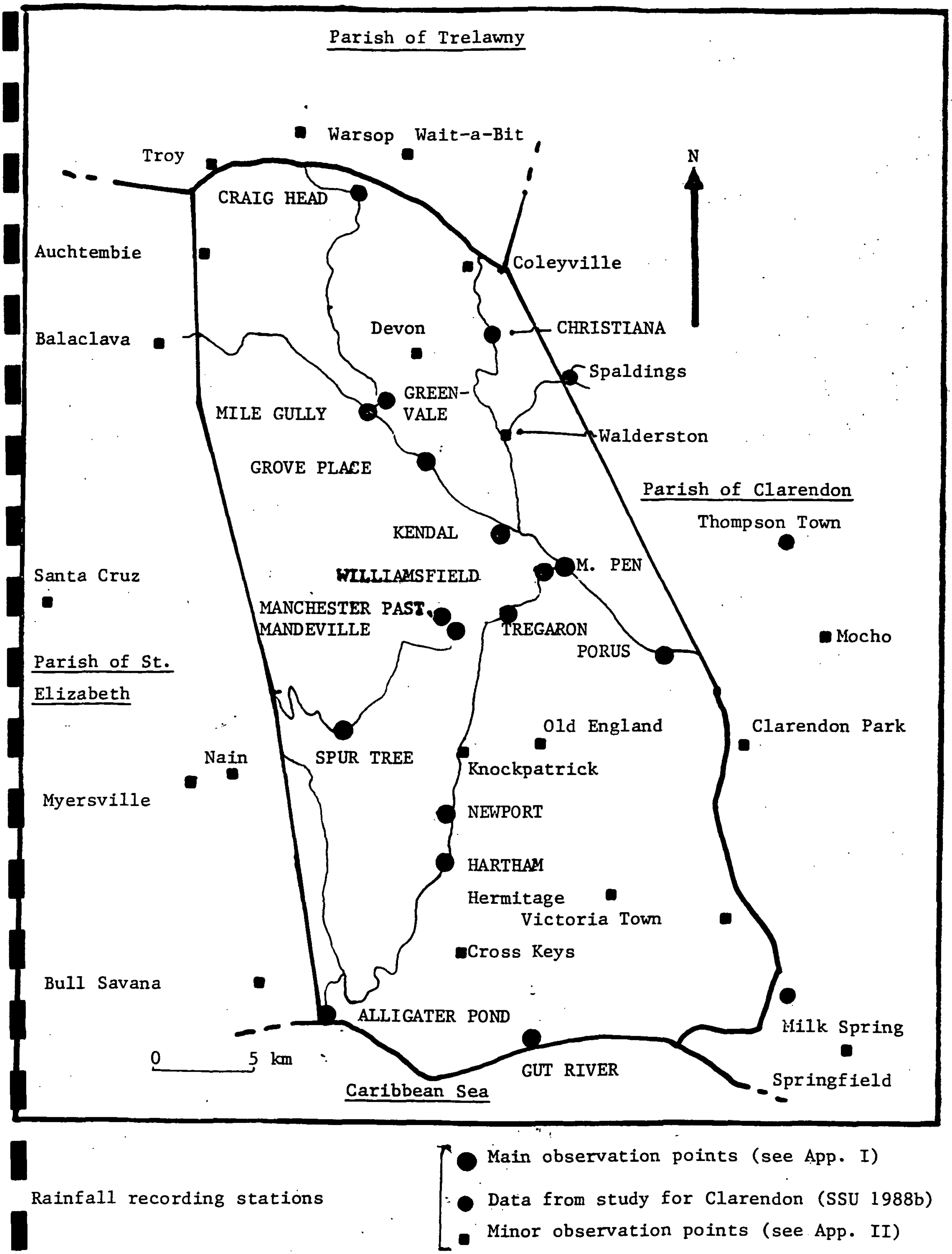


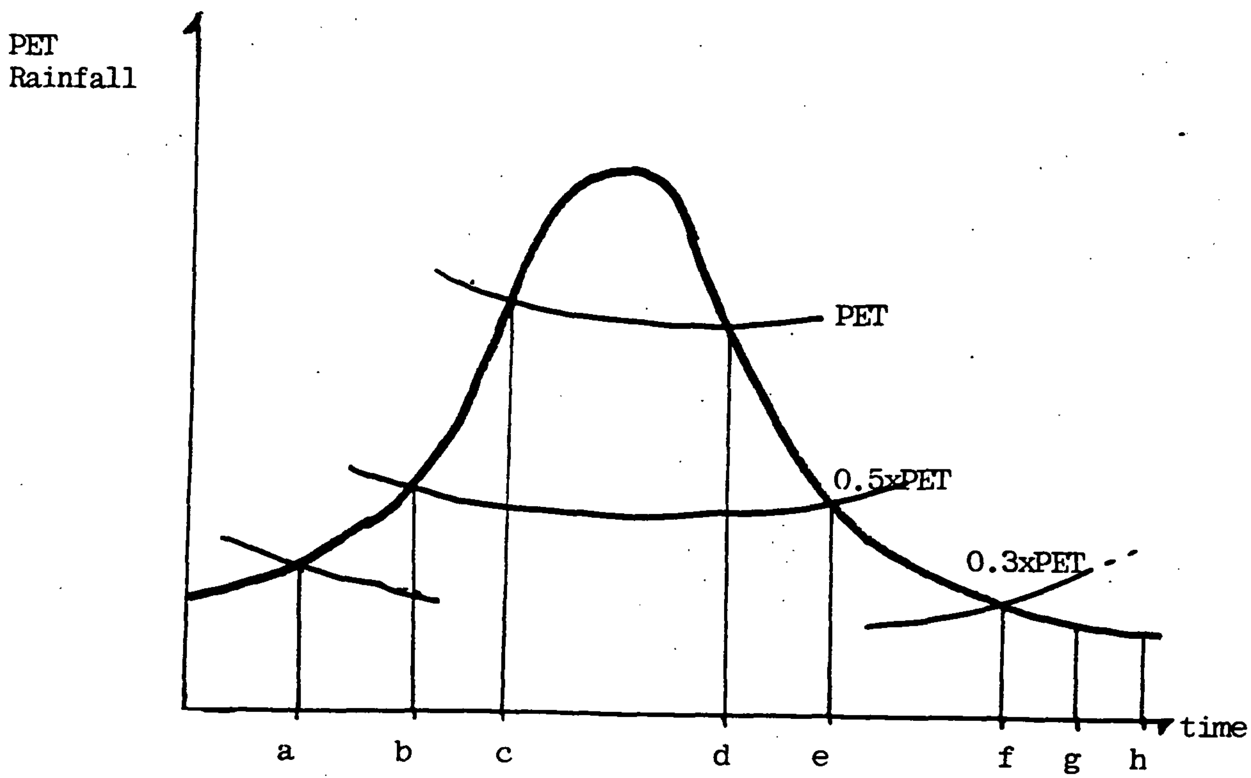
Figure 1. Location of rainfall stations in Manchester and the surrounding parishes.

3. RAINY SEASON AND GROWING PERIOD

Crop water requirements are related to an empirical crop coefficient, which varies with the crop's growing stage, relative humidity and wind speed, and potential evapo-transpiration (see FAO 1979).

Rainfed crops usually suffer badly from drought when monthly precipitation is less than 0.3xPET (e.g. Cochrane 1975). The minimum seasonal water requirement needed to ensure satisfactory, but not optimum, production of upland crops under rainfed conditions is frequently set at 0.5xPET in agro-climatic studies (e.g. FAO 1981, IICA 1983, SSU 1988b). Water requirements of mature upland crops are fully covered when precipitation exceeds PET.

Taking the above into consideration a rainfall curve can be partitioned into phases that are of significance to the agriculturalist. This aspect is illustrated in Figure 2 using a hypothetical rainfall curve.



LEGEND:

af : rainy season
ab : field preparation
bc : sowing/planting (pre-humid phase)
cd : humid phase
de : post-humid phase

bg : growing period (low AWC)
bh : growing period (high AWC)

Figure 2. Schematic representation of the onset and length of the rainy season and growing period.

The rainy season is demarcated as the period in which precipitation surpasses 0.3xPET. After its onset rainfall gradually increases from 0.3 to 0.5xPET so that the surface soil will be sufficiently wetted to enable field preparation. Rainfall at this stage is generally low and erratically distributed in space and time. As a result it will be risky to plant crops, even though the water requirements of young crops only range from 0.3 to 0.5xPET in the early stages of development.

Most crops can be safely planted during the pre-humid phase in which rainfall increases from 0.5xPET to 1xPET. Planting should be done in such a way the period of maximum crop water use coincides with the period of maximum water availability, which corresponds with the humid period. Rainfall at that time exceeds PET so that there will be a rainfall surplus. Part of this excess will be lost from the soil-crop system as run-off and/or deep percolation and the remainder stored as soil moisture reserve. The "crop available fraction" of these reserves can be utilized by crops during dry spells which may occur during the post humid phase, the period in which preciptitation decreases from 1.0 to 0.5xPET. Rainfall conditions during the post humid phase are suited for crop ripening (e.g. grains and pulses) and harvesting.

Crop growth is reduced when the water supply, the sum of rainfall and crop available soil moisture, drops below the equivalent of 0.5xPET. The period in which water supply exceeds 0.5xPET is considered to correspond with the growing period.

In a given "rainfall" zone the length of the growing period will vary with the topography, soil characteristics and management conditions (see intervals "bg" and "bh" in Figure 2). These variables determine to a great extent which percentage of the precipitation will be stored in the soil or lost as run off.

The above defined "pedo-climatic" growing-period is not the same as the growing season of a crop. The growing season corresponds with the time span needed by a particular crop to reach maturity under non-limiting conditions of climate, soils and management. Agro-climatic crop zoning studies thus can be based on the comparison of the crop's growing season requirements with the characteristics of the growing periods encountered in a given location.

The distribution of precipitation in space and time is highly variable throughout Jamaica. This implies that the concept of growing period, as defined earlier, can only be applied meaningfully if it is linked to a predefined probability of occurrence. It also means that mean or average rainfall is not a reliable index for either usefulness or risk in agro-economic analyses (see SSU 1986).

Internationally, the 75 percent level of exceedance of critical (minimum) amounts of precipitation is widely used in agro-climatic risk forecasting (e.g. Cochrane 1975, FAO 1981, ICC 1986, IICA 1983, SSU 1988b). Consequently, the dependable growing period (DGP) has been defined as the number of months (consecutive) in which:

a) monthly precipitation exceeds 0.5xPET in 75 percent of the years,

b) estimated soil moisture reserves allow for satisfactory crop growth and harvesting, and

c) other climatic factors are not limiting for the specified crop (e.g. air temperature and photo-periodicity).

In view of the resolution level (monthly data), the maximum effective length of the period of soil water is arbitrarily set at 1 month when:

a) 0.3xPET <= R75 < 0.5xPET in month i, and

b) 0.5xPET <= R75 in the preceding month (i-1).

It is further assumed that the soils are deep and freely drained. The estimated period of soil water use is indicated with a "u" in Table 2.

This general approach is only justified in regional studies of moisture availability at scale 1:100,000 to 1:250,000. More detailed studies should be based on soil-water budgetting models. Ideally, such models should consider 5-day or 10 day climatic data so that temporal water supply can be studied in relation to critical crop development stages (see SSU 1989a).

Islandwide studies of the above kind are not yet feasible in Jamaica because records of daily climatic data are mainly stored in manuscript form at the Meteorological Office. As such, they are not readily available for computerized processing (see also IICA 1982).

4. RESULTS AND DISCUSSION

4.1 Annual rainfall pattern

The statistics that are presented in Appendix I indicate that the distribution of precipitation in space and time is highly variable in Manchester. The seasonal pattern is strongly related to factors such as proximity to the Caribbean Sea, topography and the effects of meteorological phenomena such as the inversion of the trade winds as well as micro-climatic effects and plurannual trends (see JMS 1973).

The variable nature of annual rainfall in time is clear from Table 1. At Mandeville, for instance, annual precipitation ranged from 1259-2474 mm in 80 percent of the years while median rainfall (R50) amounted to 1867 mm/year. The extremes recorded during 1951-1980, the period of time under review, are 1034 and 2703 mm/year respectively.

Table 1: Range in annual rainfall totals observed at 17 stations in Manchester (mm/year) grouped in order of increasing R75/PET ratios.

Station	Min.	R90	R50	R10	Max.	R75/PET	CV
Gut River	308	384	782	1254	1736	0.35	41
Alligator Point	491	578	972	1494	2303	0.47	36
Porus	1097	1173	1813	2453	2491	0.93	24
Hartham	781	967	1534	2124	2680	0.95	27
Spur Tree H.E.	966	984	1532	2081	2159	0.95	24
New Port	966	1046	1579	2112	2564	0.99	24
Williamsfield	1156	1234	1858	2481	2742	1.06	23
Grove Place	1090	1252	1765	2278	2676	1.07	21
Kendal	1195	1248	1894	2540	2867	1.10	24
Green Vale	1360	1321	1708	2095	2269	1.10	15
Mandeville	1034	1259	1867	2474	2703	1.14	23
Mile Gully	1199	1298	1776	2254	2466	1.14	19
Manch. Pasture	1415	1331	2033	2734	2921	1.16	24
Christiana	1251	1302	1895	2656	3456	1.20	27
Marshall's Pen	1147	1392	1922	2451	2785	1.24	20
Tregeron	1333	1408	1942	2508	2749	1.24	20
Craig Head	1380	1532	2046	2560	2582	1.46	17

* See Appendix I for explanation of symbols; CV is in %.

Median rainfall (R50) along the dry coastal strip ranges from about 800 to 1000 mm/year (see Gut River and Alligator Pond). Subsequently, there is a hilly zone in which median rainfall gradually increases from 1000 to 1600 mm/year. Hartham, Spur Tree and New Port are representative for the "wetter" part of this region. Median rainfall amounts to 1850-2000 mm/year on the central limestone plateau (e.g. Mandeville, Marshall's Pen and Tregaron). Grove Place, Green Vale and Mile Gully, which occur in a somewhat lower sheltered place of the plateau, appear to receive somewhat lower rainfall than the surrounding area (R50= 1700-1800 mm/year). Median rainfall exceeds 2000 mm/year in the mountains near Craig Head.

4.2 Dependable growing period

The rainfall pattern in Manchester is bimodal with peaks centered around May and October. The following discussion shows that there are marked regional differences in the length of the dependable growing period(s).

The short rainy season (May-June) is ill defined in the coastal strip. Precipitation at that time of the year is low and of a highly variable nature. In some years the "short" rains may fail completely whereas in other years they persist as thundery, rainy weather until the month of September. The short 75% dependable growing (DGP) extends from September to the beginning of November (Table 2). Few annual crops can be grown sucessfully at this time of the year unless they are irrigated or grown in a dry farming system which includes mulching (see SSU 1989c). November-August and December-April corresponds with the long dry season at Alligator Pond and Gut River respectively. The fiercest part of this dry season mainly concurs with January-March. In the case of Gut River, cumulative rainfall for the period January to March ranges from 12 to 107 mm in 80 percent of the years (R75/PET=0.06).

There are two well defined DGPs at Hartham, New Port, Porus and Spur Tree. The short DGP extends from the middle of April till the beginning of July. It is generally followed by a short dry season, but in some years the "short rains" may persist as thundery storms until August. The main DGP extends from August to December, September and October being the wettest months. The dry season starts in January and ends in April.

There is a net surplus of annual rainfall in the remaining part of the parish, particularly in the mountains near Craig Head. On the limestone plateau the R75/PET ratios range from 1.06 to 1.24 at the stations under review. This indicates that a wide range of upland crops can be grown under rainfed conditions. The DGP extends from April to December and includes an ill defined period of somewhat lower precipitation (June-July). Highest precipitation is recorded in October and November when storms are often of a torrential nature so that run off rates are high. January-March corresponds with the main dry period on the limestone plateau. In the case of Mandeville, which is centrally located, cumulative rainfall for January-March is 87 to 371 mm in 80 percent of the years (R75/PET=0.46).

The most humid section of the parish is located in the north-east. The DGP lasts from April to December and includes a period of somewhat lower rainfall between June and July. In 75% of the years monthly rainfall exceeds PET in the period April-May and August-October. Precipitaion is lowest between January and March. Cumulative rainfall for the period January to March amounts to 82 to 372 mm in 80 percent of the years at Craig Head (R75/PET= 0.56).

Table 2: Time of occurrence and duration of the Dependable Growing Period(s) at 17 locations in Manchester (75 percent probability of occurrence).

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gut River	-	-	-	-	-	-	-	-	p	M	-	-
Alligator Po.	-	-	-	-	p	-	-	p	M	M	u	-
Porus	-	-	-	p	M	M	u	M	H	H	M	u
Hartham	p	-	-	p	M	u	p	M	M	H	M	u
New Port	p	-	p	p	M	M	u	M	H	H	M	u
Spur Tree	u	-	p	M	M	M	u	M	H	H	M	M
Mile Gully	-	-	p	M	M	u	M	M	H	H	M	u
Green Vale	-	-	M	M	H	u	M	M	H	H	M	-
Mandeville	p	-	p	M	M	M	M	M	H	H	M	u
Marshall Pen	-	p	p	M	M	M	M	M	H	H	M	u
Grove Place	-	-	p	M	H	M	M	M	H	H	M	u
Kendal	-	-	p	M	H	M	M	M	H	H	M	u
Christiana	-	p	M	M	H	M	M	M	H	H	M	u
Williamsfield	-	-	p	M	M	M	M	H	H	H	M	u
Manchester P.	u	-	-	M	M	M	M	H	H	H	M	M
Tregeron	-	-	p	M	H	H	M	M	H	H	M	M
Craig Head	p	-	p	H	H	M	u	H	H	H	M	u

-: month in which R75<0.3xPET ("dry" in => 25% of the years)
p: month in which 0.3<=R75/PET<0.5 (field preparation possible)
M: month in which 0.5 <= R75/PET< 1.0 (sowing/planting or harvesting recommended)
H: month in which 1.0 <= R75/PET (period of water surplus)
u: utilization of "last" rains plus stored soil moisture

Appendix I includes analyses of rainfall in which each monthly period within a specific year is considered as an independent event. Generally, the agronomist also requires an insight with regard to the rainfall total (cumulative) that can be expected during the dependable growing period (Table 3) and the probability of occurrence of having either a "dry" or a "very wet" month (Table 4 and 5).

Table 3 further provides statistics for cumulative rainfall recorded during the period April-June which approximately corresponds with the time of occurrence of the "short rains" at

Gut River, Alligator Pond, and the "short DGP" at Hartham, New Port, Porus and Spur Tree.

Table 3: Range in rainfall totals recorded during the main 75%-dependable growing period and "short rainy season" (April-June) respectively at 17 locations in Manchester.

Station	75%-DGP	N	PET	Min	R90	R75	R50	R25	R10	Max	R/P
Gut River	Oct-Nov	20	232	49	68	128	225	363	538	1059	0.55
	Apr-June	20	448	23	15	61	145	265	409	601	0.13
Alligator P.	Sep-Nov	42	359	140	191	282	403	552	717	1259	0.78
	Apr-June	44	448	43	50	143	257	383	509	765	0.31
Porus	Aug-Dec	16	611	659	581	714	881	1078	1293	1784	1.16
	Apr-June	20	448	187	162	372	628	907	1184	1644	0.83
Hartham	Aug-Dec	18	508	482	492	641	811	987	1157	1492	1.26
	Apr-June	21	356	146	118	272	439	605	759	911	0.76
New Port	Aug-Dec	22	517	501	489	654	853	1074	1295	1632	1.26
	Apr-June	24	364	132	175	310	455	600	735	845	0.85
Spur Tree	Aug-Jan	13	602	574	640	743	851	958	1061	1058	1.23
	Apr-June	14	361	217	150	303	483	677	873	1046	0.83
Grove Place	Apr-Dec	35	1072	915	1048	1298	1573	1848	2097	2409	1.21
Kendal	Apr-Dec	24	1089	975	1022	1334	1671	2008	2321	2597	1.22
Mandeville	Apr-Dec	26	1040	886	1083	1367	1672	1976	2260	2576	1.31
Mile Gully	Apr-Dec	20	1026	1068	1081	1321	1579	1837	2078	2245	1.28
Williamsf.	Apr-Dec	12	1107	990	1036	1348	1675	2003	2314	2484	1.21
Marshall P.	Apr-Dec	27	1021	941	1191	1430	1692	1953	2193	2538	1.40
Tregaron	Apr-Dec	16	1029	1240	1234	1464	1726	2004	2281	2556	1.42
Craig Head	Apr-Dec	20	937	1313	1354	1579	1820	2062	2287	2333	1.68
Manch. Past.	Apr-Jan	13	1201	1151	1236	1596	1972	2348	2708	2829	1.32
Greenvale	Mar-Nov	17	1082	989	1022	1252	1495	1739	1968	2048	1.15
Christiana	Mar-Dec	29	1118	1113	1175	1437	1766	2144	2538	3333	1.28

* R/P is the abbreviation for R75/PET

4.3 Probability of occurrence of "dry" months

The actual probability (i.e. non-transformed data) of a particular month being "dry", i.e. receiving less than 0.3xPET mm of rainfall, is shown in Table 4. The results are self-explanatory.

Table 4. Probability of receiving less than 0.3xPET mm of rainfall per month (dry month) at 17 locations in Manchester grouped according to increasing R75/PET ratios.

Station	time period	J	F	M	A	M	J	J	A	S	O	N	D
Gut River	1931 - 1951	82	88	96	77	64	60	70	40	15	5	35	60
Alligator Pond	1915 - 1972	73	49	60	41	30	57	59	25	14	4	10	44
Porus	1948 - 1980	32	48	45	27	4	6	9	5	1	1	6	11
Hartham	1955 - 1980	15	47	28	6	1	29	30	6	0	0	15	16
Spur Tree H.E.	1960 - 1980	28	41	27	7	14	13	21	8	1	7	13	23
New Port	1951 - 1980	15	44	26	7	8	13	27	2	1	1	13	23
Williamsfield	1951 - 1980	37	39	25	10	17	13	7	1	1	1	1	35
Grove Place	1931 - 1977	43	27	21	6	0	10	9	1	4	0	4	29
Kendal	1931 - 1972	33	39	27	14	2	10	2	4	1	0	8	20
Greenvale	1951 - 1972	53	31	11	1	2	5	14	10	2	1	1	40
Mandeville	1951 - 1980	26	24	21	12	8	18	5	4	0	0	5	11
Mile Gully	1951 - 1980	41	26	18	1	9	8	5	1	4	1	5	20
Manchester Pas.	1963 - 1983	19	39	43	13	2	8	2	1	1	1	2	13
Christiana	1951 - 1980	18	29	19	2	2	8	1	1	1	4	8	25
Marshall Pen	1951 - 1980	29	27	24	5	8	8	8	2	1	0	1	8
Tregaron	1951 - 1972	35	26	24	1	2	7	2	1	0	1	1	1
Craig Head	1951 - 1980	24	29	16	9	1	12	25	5	5	0	13	8

Note: One year out of 40 corresponds with a probability of 2.5 percent (e.g. Alligator Pond) but 1 year out of 15 with about 7 percent (e.g. Spur Tree) [See Table 2 in App. I].

4.4 Probability of occurrence of "very wet" months

So far water deficits have been named as the main possible source of yield reduction. An excess of precipitation, however, can also lead to decreased yields (e.g. reduced pollination, water logging, flooding and mass wasting). Appendix I includes tables showing the probability of rainfall exceeding preselected monthly totals. These data can be interpreted for agronomic purposes on the basis of the following general statements.

According to ILACO (1981) nearly all annual crops require periods of reduced rainfall during sowing and harvesting and moderate rain (100-250 mm/month) during growth and flowering. ILACO further considers that more than 3 consecutive months with over 300 mm of precipitation is poorly suited for cropping, except for rice (with reduced yields), cassava and yams. For this reason, it is often recommended to sow rainfed upland crops at the end of such high rainfall periods (see H in Table 2) provided total rainfall and/or soil moisture reserves remain at a satisfactory level in the following months.

Rainfall totals in excess of 300 mm/month are tentatively considered as being indicative of a potential hazard to crop production. Marked differences exist again between the southern coastal strip, the limestone plateau and the Craig Head area (Table 5).

Table 5. Probability of surpassing 300 mm of rainfall per month at 17 locations in Manchester grouped according to increasing R75/PET ratios.

Station	time period	J	F	M	A	M	J	J	A	S	O	N	D
Gut River	1931 - 1951	0	0	0	0	0	10	0	0	0	15	5	0
Alligator Pond	1915 - 1972	2	0	0	0	4	6	0	4	6	16	6	0
Hartham	1955 - 1980	0	0	0	0	18	18	0	0	15	40	4	0
Spur Tree H.E.	1960 - 1980	0	0	0	6	18	6	0	0	12	11	0	0
New Port	1951 - 1980	0	0	0	3	21	18	0	11	20	46	0	0
Porus	1948 - 1980	0	4	0	3	40	20	0	10	25	36	4	0
Williamsfield	1951 - 1980	0	0	0	5	31	16	5	12	22	50	0	0
Grove Place	1931 - 1977	0	0	0	10	27	15	0	10	10	33	5	0
Kendal	1931 - 1972	0	0	0	2	26	23	8	9	17	28	6	0
Greenvale	1951 - 1972	0	4	0	9	30	17	0	4	8	26	0	0
Mandeville	1951 - 1980	0	0	3	13	27	26	0	14	22	46	0	0
Mile Gully	1951 - 1980	3	0	3	13	37	6	0	7	13	22	0	0
Manchester Pas.	1963 - 1983	0	0	5	18	35	29	0	23	23	47	0	0
Christiana	1951 - 1980	3	0	3	13	36	20	0	6	13	50	6	0
Marshall Pen	1951 - 1980	0	0	3	14	27	23	0	6	31	55	0	0
Tregaron	1951 - 1972	0	0	0	16	27	41	0	5	27	50	5	0
Craig Head	1951 - 1980	0	0	8	26	55	14	0	29	26	57	7	0

Note: One year out of 40 corresponds with a probability of 2.5 percent (e.g. Alligator Pond) but 1 year out of 15 with about 7 percent (e.g. Spur Tree). [See Table 2 in App. I]

5. AGRO-CLIMATIC ZONES

5.1 Class defining criteria

The climate of Manchester is marked by its seasonal and spatial variability and to a lesser degree by recurring plurannual trends and micro-climatic effects. Agro-climatic delineations based on rainfall, PET and air temperature consequently always are somewhat arbitrary, each zone showing a gradual change to the adjoining one. Figure 3 was prepared using the existing agro-climatic rating system (see SSU 1988b), with minor modifications which are explained below. For practical reasons, the legend and map are presented on separate pages at the end of this chapter.

First entry: annual R75/PET ratio.

The first entry divides the parish into zones of similar, overall moisture availability conditions. Considering the fact that only limited areas of natural vegetation remain in Jamaica it was not feasible to correlate specific ranges in R75/PET ratios with occurring changes in natural vegetation cover. This type of approach can only be applied succesfully in countries were wide expanses of natural vegetation remain (e.g. Sombroek et al. 1982).

In view of the above, the selection of critical boundaries for the moisture availability zones is mainly based on "crop-moisture" relationships discussed in FAO (1979) and ILACO (1981). Three of the four zones originally identified by SSU (1988b) occur in Manchester, viz. the "dry" (D), "intermediate" (I) and "wet" (W) zone.

Few crops can be grown under rainfed conditions if dependable rainfall divided by PET is less than 0.5. This value was therefore taken as the upper limit for the "dry" zone. Based on our present knowledge R75/PET ratios never become less than 0.3 in Jamaica. Hence the use of 0.3 value as the lower limit of the "dry" zone.

A wide range of climatically adapted upland crops can be grown satisfactorily under rainfed conditions in the "intermediate zone" in which R75/PET ratios range from 0.5 to 1.0. Particularly in those locations where the annual R75/PET ratio exceeds 0.75 (see ILACO 1981). The "intermediate zone" is therefore divided in two subzones, i.e. $0.5 \leq R75/PET < 0.75$ and $0.75 \leq R75/PET < 1.0$ respectively.

It is recognized that the choice of the "0.75" boundary is somewhat arbitrary. Cochrane (1975) in a study of the lowlands of Colombia advocated the use of 0.66 as an approximate measure for moisture sufficiency levels. This type of regional "refinments" can only be made on the basis of agricultural research.

The "wet" zone is defined as an area having a moisture surplus in at least 75 percent of the years. It is demarcated using R75/PET ratios of 1.0 and 1.5 respectively. The latter value forms the lower boundary condition for delineating the "very wet" zone.

Field observations, which were made during the ongoing national soil survey programme, indicate that agricultural conditions in the "wet" and "very wet" zone differ markedly in Jamaica. The "very wet" zone receives high rainfall throughout the year, while there are still clear short dry periods in the "wet" zone. As such the two zones differ in terms of overall "crop suitability". The "very wet" zone is most suited for crops which do not require a clear dry period to ensure good growth and harvesting.

<u>Second entry</u>: time of occurrence of the 75% dependable growing period(s).

The R75/PET ratio provides general information about moisture availability to crops during the year. For instance, a R75/PET ratio of 0.75 implies that there will be 75 percent of full moisture months in a year in 3 out of 4 years. The R75/PET ratio cannot tell how the rainfall "peaks" are distributed. Recording stations with similar R75/PET ratios may show somewhat different seasonal rainfall patterns. Examples of this feature are included in Table 1 and 2 (see Hartham and Spur Tree; Kendal and Green Vale; Mandeville and Mile Gully; Marshall's Pen and Tregaron).

The regional distribution of the dependable growing period(s) over the year is described in general terms at the second level in the map unit code. It should be noted that the agronomic meaning of the roman numerals (e.g. D<u>i</u>a) may vary from one geographical area to the other, so that other descriptions may be needed for second level entries in the other parishes. Descriptions for entries at the second level can only be finalized once all parishes have been covered.

The delineation of moisture availability zones and subzones is based on the interpretation of the "rainfall" statistics in Table 1 and 2 using topographical features at scale 1:250,000 (Survey Department 1972). The boundaries are most accurate in those areas were the intensity of observations is highest (see Figure 1).

<u>Third entry</u>: air temperature regime.

Air temperature is the third main climatic factor, after rainfall and PET, that determines crop productivity. In the study for Clarendon (SSU 1988b) air temperature was used as the second entry. This sequence could not be applied succesfully in Manchester where the moisture availability zones and thermal zones do not run concurrently. It is for this reason that the thermal regime is now visualized at the third level in the map unit code (e.g. D1a). An additional modification is that two temperature zones have now been defined within the 600-1500m range in elevation, i.e. the 600-900 and 900-1500m zone respectively. This refinment permits better matching of air temperature requirements of "high altitude" crops with the prevailing thermal conditions.

Air temperature in Jamaica is linearly related to elevation above mean sea level (SSU 1988a). Temperature zones are plotted on the basis of the 1000 feet contour lines shown on the 1:250,000 topographical map of Jamaica (Survey Department 1972). These intervals correlate well with the temperature requirements of the important export crops such as banana, sugar cane, coconut and coffee.

5.2 Possible applications

Figure 3 may serve as the basis for regional crop zoning studies in Manchester. First, the agro-climatic requirements of the pertinent crop have to be determined. For instance through a search of literature (e.g. Booker 1984, FAO 1979, ILACO 1981, Purseglove 1968, Royes and Barnes 1988) or from local experience. Subsequently, these requirements are matched with the agro-climatic conditions with a view to demarcating zones of similar agro-climatic suitability for the crop under consideration.

The data base developed within the framework of this study can be used to determine the agro-ecological potential of the soils of northern Manchester for well defined land utilization types using the computerized JAMPLES system (SSU in prep.).

The possibility of using the gathered agro-climatic data sets for the mapping of agro-ecological zones for the island using the Jamaica Geographical Information System was already discussed in the introduction.

LEGEND TO THE AGRO-CLIMATIC ZONES MAP OF MANCHESTER
(scale 1:250,000)

D: Dry moisture availability zone

D1: 0.3<=R75/PET<0.4

D1a: dry with one dependable growing period from October to November and a marked dry season from December to August; mean annual air temperature (Tmean) about 24-26 degrees Celsius.

D2: 0.4<=R75/PET<0.5

D2a: dry with one dependable growing period from September to November, a marked dry season from December to April, and a short dry period in June and July; Tmean about 24-26 degrees Celsius.

D2b: as above, but Tmean about 22-24 degrees Celsius.

I: Intermediate moisture availability zone

I1: 0.5<R75/PET<0.75

I1a: intermediate with two dependable growing periods (August-December and April-June respectively) and the main dry season from December to April; Tmean about 24-26 degrees Celsius.

I1b: as above, but Tmean about 22-24 degrees Celsius.

I1c: as above, but Tmean about 20-22 degrees Celsius.

I2: 0.75<=R75/PET<1.00

I2a: intermediate with one dependable growing period from April to December and a short dry season from January to March; Tmean about 24-26 degrees Celsius.

I2b: as above, but Tmean about 22-24 degrees Celsius.

I2c: as above, but Tmean about 20-22 degrees Celsius.

W: Wet moisture availability zone

W1: 1.00<=R75/PET<1.25

W1a: wet with one long dependable growing period from April to December and a short dry season from January to March; Tmean about 24-26 degrees Celsius.

W1b: as above, but Tmean about 22-24 degrees Celsius.

W1c: as above, but Tmean about 20-22 degrees Celsius.

W1d: as above, but Tmean about 17-20 degrees Celsius.

W2: 1.25<=R75/PET<1.50

W2d: wet with one long dependable growing period from April to December and a short dry season centered around February; Tmean about 17-20 degrees Celsius.

Note: R75 is the 75% dependable rainfall and PET potential evapo-transpiration calculated according to Priestley and Taylor.

Key to thermal codes (degrees C)

Code	a	b	c	d	e
Tmin.	19-22	17-19	16-17	13-16	9-13
Tmean	24-26	22-24	20-22	17-20	13-17
Tmax.	29-32	27-29	25-27	22-25	18-22
Alt.(x100m)	0-3	3-6	6-9	9-15	>15

* Alt. is the approximate range in elevation.

[Please see next page for agro-climatic zones map]

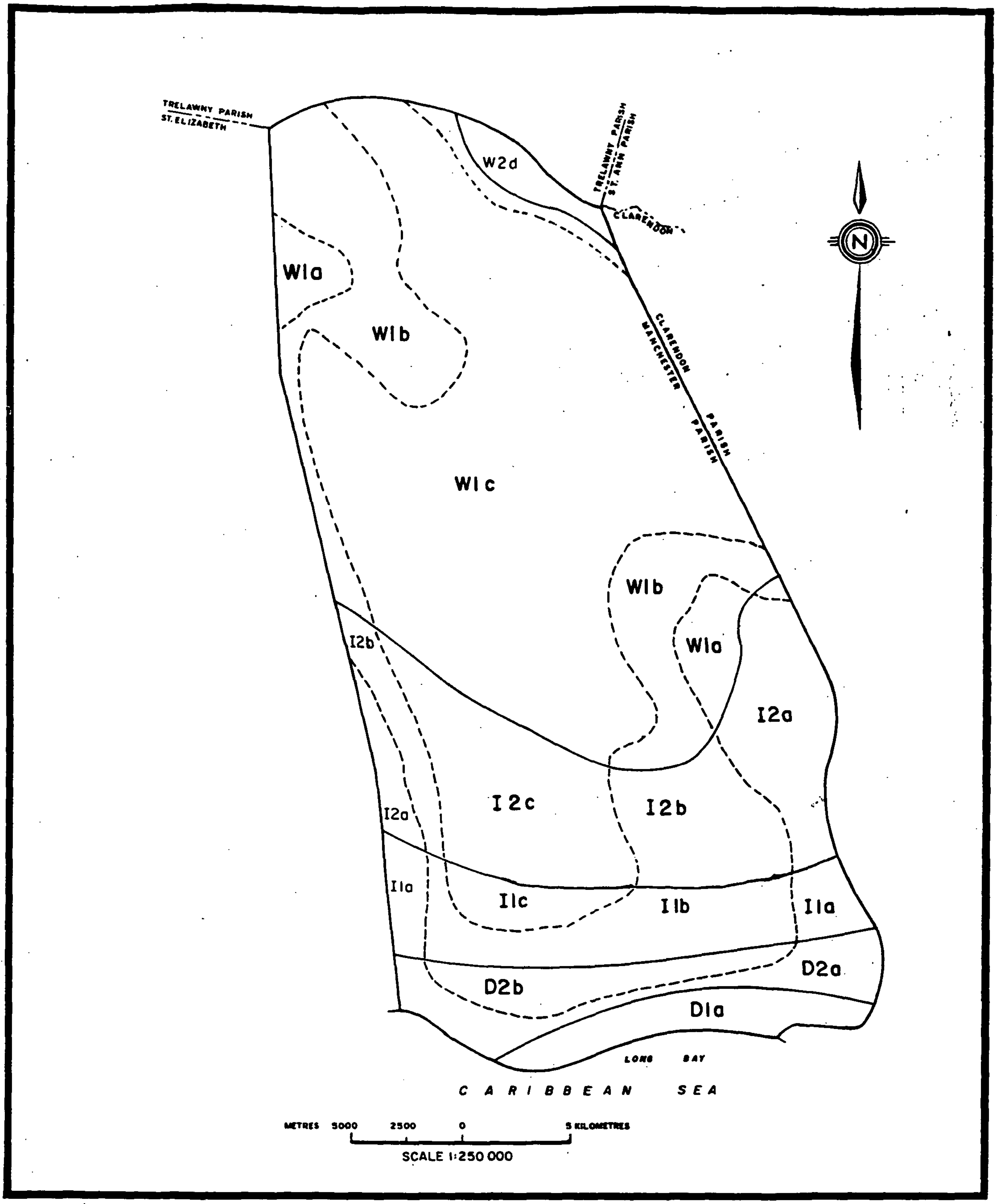


Figure 3: Agro-climatic zones map for the parish of Manchester.
(See the preceding page for the legend)

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APPENDIX I

Agro-climatic profiles for selected locations in the parish of Manchester, Jamaica.

Explanatory note:

The following variables are presented for each station:

N: the sample size -number of records- for each month or year.

Mean: the arithmetic mean for month-i or the year.

CV: the coefficient of variation is a measure for the variability of total rainfall in the period under study in time (in percent).

Minim.: lowest total amount of monthly rainfall recorded during the period under review.

R90: the amount of rainfall that will be reached or exceeded in 90 percent of the years.

R75: as above, but this amount will be reached or exceeded in 75% of the years (synonym: dependable rainfall).

R50: as above, but this amount will be reached or exceeded in 50 percent of the years (median).

R25: as above, but this amount will be reached or exceeded in 25 percent of the years.

R10: as above, but this amount will be reached or exceeded in 10 percent of the years.

Maxim.: highest amount of total rainfall recorded during the period under review.

R90 to R10: corresponds with the range in precipitation observed during the specified time period in 80 percent of the years.

PET: Potential evapo-transpiration - Priestley and Taylor's - calculated with linear regression against elevation (IICA 1983).

DGP-75%: the dependable growing period at the 75 percent level of statistical confidence (see alsoe Table 2 in the body of the report).

Precipitation and PET are expressed in mm/month respectively mm/year [1 inch = 25.4 mm].

Tmin., Tmean and Tma.: Air temperature is calculated with linear regression and expressed in degrees Celsius (SSU 1988b).
[deg F = 32 + 9/5xdeg C]

Alligator Pond

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Alligator Pond (in mm/month and degrees Celsius respectively) [data base: 1915 - 1972]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	42	44	43	48	50	47	44	48	47	50	46	44	29
Mean	39	44	47	71	122	81	54	110	133	201	100	47	1008
CV (%)	146	94	105	88	74	138	120	83	70	64	85	81	36
Minim.	0	0	0	0	2	0	0	0	0	19	0	0	491
R90	1	0	0	0	8	3	1	14	26	57	16	0	578
R75	7	15	12	27	58	15	12	46	67	111	43	21	752
R50	23	40	37	66	118	47	36	96	123	186	85	47	972
R25	52	69	72	110	183	108	76	160	189	275	143	74	1227
R10	94	98	111	155	243	199	131	229	255	369	207	98	1494
Maxim.	306	161	204	248	401	472	291	423	430	669	409	151	2303
PET	106	112	143	147	154	149	158	147	127	125	107	106	1580
R75/PET	0.07	0.12	0.08	0.18	0.37	0.09	0.07	0.31	0.52	0.89	0.39	0.19	0.47
DGP-75%	-	-	-	-	p	-	-	p	M	M	u	-	
Tmin	19.0	18.7	19.1	20.1	21.4	22.1	22.0	22.1	22.1	21.8	21.1	20.2	20.8
Tmean	23.9	23.8	24.1	25.0	25.9	26.5	26.8	27.1	26.7	26.5	25.8	24.8	25.6
Tmax	28.9	29.0	29.5	30.0	30.4	30.9	31.4	31.6	31.3	30.9	30.2	29.4	30.3

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Alligator Pond [in %; data base: 1915 - 1972 , elev.= 5 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	73	49	60	41	30	57	59	25	14	4	10	44
P(.3<=X<.5)	11	27	23	25	4	19	22	18	6	4	17	18
P(.5<=Xi<1)	7	15	11	22	36	12	13	39	38	20	47	29
P(1<=Xi)	9	9	6	12	30	12	6	18	42	72	26	9
P(2<=Xi)	2	0	0	0	4	8	0	4	6	24	8	0
P(R> 25mm)	40	59	58	75	86	61	59	89	93	98	91	61
P(R> 50mm)	16	29	37	52	70	40	36	70	82	92	73	45
P(R> 75mm)	14	18	18	33	66	25	22	54	70	92	50	18
P(R>100mm)	9	13	16	27	50	21	15	41	59	80	36	11
P(R>150mm)	7	2	6	12	32	12	6	18	34	64	19	2
P(R>200mm)	2	0	2	6	22	12	4	16	17	36	8	0
P(R>300mm)	2	0	0	0	4	6	0	4	6	16	6	0
P(R>400mm)	0	0	0	0	2	4	0	2	4	10	2	0
P(R>500mm)	0	0	0	0	0	0	0	0	0	4	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Christiana

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Christiana (in mm/month and degrees Celsius respectively) [data base: 1951 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	30	29	29	29	30	30	30	30	30	30	30	30	29
Mean	61	63	114	181	292	192	120	172	201	316	137	74	1942
CV (%)	94	68	61	60	77	98	37	40	47	51	83	71	27
Minim.	3	0	21	39	48	32	55	42	55	23	22	0	1251
R90	12	4	19	33	82	39	59	79	73	111	33	2	1302
R75	26	32	65	104	146	76	88	122	134	201	64	36	1566
R50	49	63	114	181	248	144	120	171	201	308	113	74	1895
R25	84	93	163	258	391	253	152	221	267	424	185	111	2269
R10	128	121	209	329	567	404	181	268	328	536	274	145	2656
Maxim.	302	183	307	427	1215	950	213	372	457	777	588	206	3456
PET	90	91	112	115	124	125	132	126	109	106	87	89	1304
R75/PET	0.28	0.35	0.57	0.90	1.17	0.61	0.66	0.97	1.23	1.89	0.72	0.41	1.20
DGP-75%	-	p	M	M	H	M	M	M	H	H	M	u	
Tmin	15.0	14.6	15.0	15.9	17.2	17.9	17.8	17.9	17.8	17.6	17.0	16.0	16.6
Tmean	19.6	19.4	20.0	20.9	21.7	22.1	22.5	22.8	22.4	22.0	21.3	20.3	21.2
Tmax	24.2	24.3	25.1	25.9	26.1	26.4	27.1	27.6	27.0	26.3	25.5	24.7	26.0

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Christiana [in %; data base: 1951 - 1980 , elev.= 810 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	18	29	19	2	2	8	1	1	1	4	8	25
P(.3<=X<.5)	36	3	10	10	6	16	10	3	0	0	6	16
P(.5<=Xi<1)	33	51	20	20	6	30	53	26	16	0	23	16
P(1<=Xi)	13	17	51	68	86	46	36	70	83	96	63	43
P(2<=Xi)	6	3	6	27	43	20	0	10	40	70	23	6
P(R> 25mm)	83	75	89	100	100	100	100	100	100	96	93	76
P(R> 50mm)	40	65	72	89	96	86	100	96	100	96	80	53
P(R> 75mm)	20	31	68	82	93	73	80	96	90	96	73	43
P(R>100mm)	13	13	58	72	90	63	66	86	90	96	50	30
P(R>150mm)	6	6	24	58	73	43	30	63	66	93	36	6
P(R>200mm)	3	0	13	37	56	33	6	26	46	73	13	3
P(R>300mm)	3	0	3	13	36	20	0	6	13	50	6	0
P(R>400mm)	0	0	0	6	20	10	0	0	3	16	3	0
P(R>500mm)	0	0	0	0	13	6	0	0	0	13	3	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Craig Head

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Craig Head (in mm/month and degrees Celsius respectively) [data base: 1951 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	23	26	25	26	27	27	26	27	26	26	26	25	16
Mean	71	61	119	222	371	168	103	226	246	377	170	80	2046
CV (%)	85	85	116	61	57	80	68	55	44	38	82	71	17
Minim.	0	0	0	6	79	0	21	24	13	132	5	14	1380
R90	0	3	11	36	125	14	6	56	98	176	5	20	1532
R75	27	24	35	126	222	70	53	138	169	273	69	41	1778
R50	69	54	83	222	349	152	103	226	246	377	158	72	2046
R25	113	92	165	319	498	251	153	315	324	481	260	111	2314
R10	156	131	280	409	655	355	200	397	395	578	361	155	2560
Maxim.	223	218	668	576	1091	590	287	557	465	690	645	278	2582
PET	85	84	102	104	113	116	124	118	103	99	81	83	1212
R75/PET	0.32	0.28	0.33	1.21	1.96	0.59	0.42	1.16	1.64	2.75	0.85	0.49	1.46
DGP-75%	p	-	p	H	H	M	u	H	H	H	M	u	
Tmin	15.6	15.1	15.5	16.5	17.8	18.4	18.4	18.5	18.4	18.2	17.5	16.6	17.2
Tmean	20.2	20.0	20.6	21.5	22.2	22.7	23.1	23.4	23.0	22.6	21.9	20.9	21.8
Tmax	24.8	24.9	25.7	26.4	26.7	27.1	27.7	28.1	27.6	26.9	26.2	25.3	26.6

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Craig Head [in %; data base: 1951 - 1980 , elev.= 700 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	24	29	16	9	1	12	25	5	5	0	13	8
P(.3<=X<.5)	21	15	24	0	0	11	15	3	0	0	3	24
P(.5<=Xi<1)	21	30	32	7	7	18	26	18	3	0	19	28
P(1<=Xi)	34	26	28	84	92	59	34	74	92	100	65	40
P(2<=Xi)	13	7	20	46	74	25	3	55	65	92	46	8
P(R> 25mm)	78	73	88	92	100	88	96	96	96	100	88	88
P(R> 50mm)	47	38	64	92	100	88	65	92	96	100	76	60
P(R> 75mm)	43	30	48	88	100	77	53	88	96	100	65	52
P(R>100mm)	21	23	28	84	92	62	46	81	92	100	61	24
P(R>150mm)	13	7	24	69	92	40	23	62	84	96	46	8
P(R>200mm)	4	3	20	46	81	25	11	55	65	92	42	4
P(R>300mm)	0	0	8	26	55	14	0	29	26	57	7	0
P(R>400mm)	0	0	4	7	37	7	0	3	15	42	3	0
P(R>500mm)	0	0	4	7	18	3	0	3	0	26	3	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Hartham

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Hartham (in mm/month and degrees Celsius respectively) [data base: 1955 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	22	22	22	22	22	22	21	22	20	22	22	21	18
Mean	69	42	56	95	190	152	83	156	201	290	103	70	1540
CV (%)	73	90	68	62	62	92	65	45	83	42	71	52	27
Minim.	20	0	16	21	47	16	9	20	47	133	5	19	781
R90	15	0	16	35	25	2	7	59	63	137	7	19	967
R75	34	14	30	55	104	52	44	106	104	203	49	43	1236
R50	61	38	50	85	190	134	83	156	169	283	101	70	1534
R25	97	66	76	125	276	236	122	207	262	371	155	97	1839
R10	137	94	107	172	356	343	158	254	381	457	206	122	2124
Maxim.	204	133	183	289	434	481	201	278	844	592	313	142	2680
PET	89	90	111	113	122	123	131	124	108	105	86	88	1289
R75/PET	0.37	0.15	0.26	0.49	0.85	0.42	0.33	0.85	0.96	1.94	0.57	0.49	0.95
DGP-75%	p	-	-	p	M	u	p	M	M	H	M	u	
Tmin	15.1	14.7	15.1	16.0	17.3	18.0	17.9	18.0	17.9	17.7	17.1	16.1	16.7
Tmean	19.7	19.5	20.1	21.0	21.8	22.2	22.6	22.9	22.5	22.1	21.4	20.4	21.3
Tmax	24.3	24.4	25.2	26.0	26.2	26.5	27.2	27.7	27.1	26.4	25.6	24.8	26.1

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Hartham [in %; data base: 1955 - 1980 , elev.= 792 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	15	47	28	6	1	29	30	6	0	0	15	16
P(.3<=X<.5)	36	9	36	13	9	4	9	4	5	0	13	14
P(.5<=Xi<1)	22	31	27	54	22	27	47	31	20	0	13	42
P(1<=Xi)	27	13	9	27	68	40	14	59	75	100	59	28
P(2<=Xi)	4	0	0	4	27	22	0	4	20	72	13	0
P(R> 25mm)	86	54	77	95	100	90	80	95	100	100	86	90
P(R> 50mm)	45	31	36	86	95	72	66	95	95	100	72	61
P(R> 75mm)	31	13	22	54	86	63	61	86	90	100	59	33
P(R>100mm)	27	13	9	27	72	45	33	77	80	100	54	23
P(R>150mm)	9	0	4	9	54	31	14	59	65	95	22	0
P(R>200mm)	4	0	0	9	36	27	4	31	25	77	9	0
P(R>300mm)	0	0	0	0	18	18	0	0	15	40	4	0
P(R>400mm)	0	0	0	0	13	9	0	0	5	13	0	0
P(R>500mm)	0	0	0	0	0	0	0	0	5	9	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Kendal

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Kendal (in mm/month and degrees Celsius respectively) [data base: 1931 - 1972]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	32	29	31	34	34	34	34	33	34	32	30	27	21
Mean	51	72	72	154	241	196	136	185	213	283	137	57	1894
CV (%)	65	106	65	54	66	78	61	52	44	52	87	57	24
Minim.	3	6	4	19	45	15	45	23	73	121	20	0	1195
R90	6	6	8	41	88	25	52	68	86	136	30	12	1248
R75	27	22	38	95	139	89	81	117	147	187	60	34	1558
R50	51	54	72	154	214	180	122	178	213	260	111	57	1894
R25	75	103	105	213	314	288	176	246	278	353	186	81	2230
R10	97	166	136	267	432	400	239	315	339	461	280	103	2540
Maxim.	145	277	194	371	986	655	374	482	442	797	533	130	2867
PET	96	99	124	127	136	134	143	134	116	113	95	95	1413
R75/PET	0.28	0.22	0.30	0.74	1.02	0.66	0.56	0.87	1.26	1.65	0.63	0.35	1.10
DGP-75%	-	-	p	M	H	M	M	M	H	H	M	u	
Tmin	16.8	16.4	16.8	17.8	19.1	19.7	19.7	19.7	19.7	19.4	18.8	17.8	18.5
Tmean	21.5	21.4	21.8	22.7	23.5	24.1	24.4	24.7	24.3	24.0	23.3	22.3	23.1
Tmax	26.2	26.4	27.0	27.7	28.0	28.4	29.0	29.3	28.9	28.3	27.6	26.8	27.9

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Kendal [in %; data base: 1931 - 1972 , elev.= 457 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	33	39	27	14	2	10	2	4	1	0	8	20
P(.3<=X<.5)	18	17	25	8	2	11	14	3	0	0	6	29
P(.5<=Xi<1)	37	24	29	8	17	32	55	27	14	0	36	37
P(1<=Xi)	12	20	19	70	79	47	29	66	85	100	50	14
P(2<=Xi)	0	10	0	11	35	29	8	15	35	53	23	0
P(R> 25mm)	78	72	83	94	100	97	100	96	100	100	93	81
P(R> 50mm)	46	44	58	82	97	91	94	96	100	100	86	51
P(R> 75mm)	25	24	45	79	97	79	82	93	97	100	66	25
P(R>100mm)	9	20	25	70	88	70	61	90	88	100	46	14
P(R>150mm)	0	17	6	52	76	41	26	54	70	90	26	0
P(R>200mm)	0	10	0	29	47	35	14	33	50	71	23	0
P(R>300mm)	0	0	0	2	26	23	8	9	17	28	6	0
P(R>400mm)	0	0	0	0	5	14	0	6	5	12	6	0
P(R>500mm)	0	0	0	0	2	5	0	0	0	9	3	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Gut River

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Gut River (in mm/month and degrees Celsius respectively) [data base: 1931 - 1951]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	21	21	21	21	21	20	20	20	20	20	20	20	20
Mean	18	20	12	28	57	98	62	96	111	173	95	32	800
CV (%)	102	157	119	84	93	143	143	85	60	61	159	89	41
Minim.	0	0	0	3	4	1	0	3	13	24	6	0	308
R90	1	0	0	0	5	1	1	0	18	25	6	1	384
R75	5	2	2	11	20	12	9	37	62	96	20	11	564
R50	14	10	9	26	47	49	34	96	111	173	53	29	782
R25	27	27	19	43	84	129	84	154	160	251	119	50	1019
R10	41	52	31	61	128	258	164	209	204	322	226	72	1254
Maxim.	77	134	44	89	230	462	352	252	231	412	707	104	1736
PET	106	112	143	147	154	149	158	147	127	125	107	106	1580
R75/PET	0.05	0.02	0.01	0.07	0.12	0.07	0.05	0.24	0.49	0.76	0.18	0.10	0.35
DGP-75%	-	-	-	-	-	-	-	-	p	M	-	-	
Tmin	19.0	18.7	19.1	20.1	21.4	22.1	22.0	22.1	22.1	21.8	21.1	20.2	20.8
Tmean	23.9	23.8	24.1	25.0	25.9	26.5	26.8	27.1	26.7	26.5	25.8	24.8	25.6
Tmax	28.9	29.0	29.5	30.0	30.4	30.9	31.4	31.6	31.3	30.9	30.2	29.4	30.3

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Gut River [in %; data base: 1931 - 1951 , elev.= 6 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	82	88	96	77	64	60	70	40	15	5	35	60
P(.3<=X<.5)	14	4	4	14	4	10	0	10	25	15	25	20
P(.5<=Xi<1)	4	4	0	9	28	10	20	20	20	25	15	20
P(1<=Xi)	0	4	0	0	4	20	10	30	40	55	25	0
P(2<=Xi)	0	0	0	0	0	15	5	0	0	30	5	0
P(R> 25mm)	23	19	19	47	66	50	45	70	95	95	75	45
P(R> 50mm)	4	9	0	9	38	35	30	60	75	85	45	20
P(R> 75mm)	4	9	0	9	33	30	30	50	60	80	35	10
P(R>100mm)	0	4	0	0	19	25	20	40	55	80	30	5
P(R>150mm)	0	0	0	0	4	20	10	30	30	50	10	0
P(R>200mm)	0	0	0	0	4	20	10	15	15	35	10	0
P(R>300mm)	0	0	0	0	0	10	5	0	0	15	5	0
P(R>400mm)	0	0	0	0	0	10	0	0	0	5	5	0
P(R>500mm)	0	0	0	0	0	0	0	0	0	0	5	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Greenvale

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Greenvale (in mm/month and degrees Celsius respectively) [data base: 1951 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	23	23	21	22	23	23	24	24	23	23	22	20	14
Mean	46	82	104	172	238	136	108	150	188	243	113	57	1708
CV (%)	88	171	51	53	61	83	45	55	49	47	55	92	15
Minim.	0	0	12	45	49	8	26	34	50	64	29	0	1360
R90	0	3	31	51	37	27	40	52	61	105	30	0	1321
R75	17	15	66	106	134	60	73	91	122	161	68	19	1506
R50	43	48	104	169	238	114	108	141	188	233	112	53	1708
R25	73	111	143	235	343	189	144	200	254	314	157	91	1909
R10	103	205	178	298	439	280	177	262	316	398	201	131	2095
Maxim.	130	719	204	423	547	474	226	431	442	614	273	195	2269
PET	94	96	119	122	131	130	138	131	113	110	92	93	1368
R75/PET	0.17	0.16	0.55	0.86	1.02	0.46	0.52	0.69	1.08	1.46	0.73	0.20	1.10
DGP-75%	-	-	M	M	H	u	M	M	H	H	M	-	
Tmin	16.2	15.8	16.2	17.1	18.4	19.1	19.0	19.1	19.1	18.8	18.2	17.2	17.9
Tmean	20.8	20.7	21.2	22.1	22.9	23.4	23.7	24.0	23.7	23.3	22.6	21.6	22.5
Tmax	25.5	25.6	26.4	27.1	27.3	27.7	28.4	28.7	28.2	27.6	26.9	26.0	27.2

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Greenvale [in %; data base: 1951 - 1980 , elev.= 578 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	53	31	11	1	2	5	14	10	2	1	1	40
P(.3<=X<.5)	13	13	14	9	8	17	8	0	8	0	13	15
P(.5<=Xi<1)	17	39	33	18	21	52	58	45	8	8	27	25
P(1<=Xi)	17	17	42	72	69	26	20	45	82	91	59	20
P(2<=Xi)	0	4	0	18	34	17	0	8	26	43	18	5
P(R> 25mm)	56	73	95	100	100	95	100	100	100	100	100	60
P(R> 50mm)	34	56	80	95	95	91	87	91	100	100	86	45
P(R> 75mm)	21	30	71	81	91	73	79	87	91	95	68	25
P(R>100mm)	17	8	47	77	78	47	50	70	86	95	45	20
P(R>150mm)	0	8	23	45	60	21	16	45	56	86	22	5
P(R>200mm)	0	4	4	27	52	17	8	16	43	56	13	0
P(R>300mm)	0	4	0	9	30	17	0	4	8	26	0	0
P(R>400mm)	0	4	0	4	21	4	0	4	4	4	0	0
P(R>500mm)	0	4	0	0	8	0	0	0	0	4	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Grove Place

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Grove Place (in mm/month and degrees Celsius respectively) [data base: 1931 - 1977]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	39	39	38	40	40	40	39	40	37	36	36	37	33
Mean	60	66	94	193	245	159	118	178	190	296	138	64	1765
CV (%)	89	92	71	56	58	81	49	47	42	55	71	76	21
Minim.	11	2	1	8	46	21	15	66	28	132	12	0	1090
R90	8	4	9	52	68	29	39	65	81	133	29	0	1252
R75	24	23	47	116	144	71	77	119	133	188	69	30	1498
R50	50	56	92	190	237	138	118	178	190	269	125	64	1765
R25	86	98	139	267	338	225	159	237	246	374	195	98	2032
R10	127	145	185	340	437	325	197	291	299	498	269	129	2278
Maxim.	224	234	270	486	758	642	296	391	381	766	438	201	2676
PET	95	97	122	125	133	132	140	132	114	112	94	94	1390
R75/PET	0.24	0.23	0.38	0.93	1.08	0.54	0.54	0.90	1.16	1.68	0.73	0.31	1.07
DGP-75%	-	-	p	M	H	M	M	M	H	H	M	u	
Tmin	16.5	16.1	16.5	17.4	18.7	19.4	19.3	19.4	19.4	19.1	18.5	17.5	18.2
Tmean	21.2	21.0	21.5	22.4	23.2	23.7	24.1	24.4	24.0	23.6	22.9	21.9	22.8
Tmax	25.9	26.0	26.7	27.4	27.6	28.1	28.7	29.0	28.5	28.0	27.2	26.4	27.5

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Grove Place [in %; data base: 1931 - 1977 , elev.= 518 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	43	27	21	6	0	10	9	1	4	0	4	29
P(.3<=X<.5)	12	23	23	2	10	15	15	2	0	0	16	13
P(.5<=Xi<1)	28	33	28	17	10	35	48	32	13	0	22	40
P(1<=Xi)	17	17	28	75	80	40	28	65	83	100	58	18
P(2<=Xi)	5	7	5	20	40	17	2	15	27	58	25	2
P(R> 25mm)	66	74	86	95	100	92	97	100	100	100	97	72
P(R> 50mm)	41	48	73	95	92	85	89	100	97	100	80	56
P(R> 75mm)	30	28	52	90	87	75	76	92	91	100	66	32
P(R>100mm)	17	17	36	82	85	62	64	75	86	100	58	18
P(R>150mm)	10	10	21	65	80	37	25	57	64	88	33	5
P(R>200mm)	2	7	7	37	57	27	7	40	43	66	22	2
P(R>300mm)	0	0	0	10	27	15	0	10	10	33	5	0
P(R>400mm)	0	0	0	7	10	7	0	0	0	19	5	0
P(R>500mm)	0	0	0	0	5	2	0	0	0	13	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Manchester Pastures

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Manchester Pastures (in mm/month and degrees Celsius respectively) [data base: 1963 - 1983]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	17	16	17	16	17	17	17	17	17	17	17	16	14
Mean	63	56	88	155	263	235	112	213	257	336	133	85	2033
CV (%)	62	92	104	77	65	85	42	41	38	47	43	53	24
Minim.	13	0	3	31	43	28	50	71	72	95	32	19	1415
R90	16	0	3	17	34	32	52	90	120	113	52	24	1331
R75	35	18	24	68	136	95	78	149	186	220	91	51	1668
R50	60	54	68	142	257	199	109	213	257	336	133	83	2033
R25	88	92	132	231	385	342	144	277	329	452	175	117	2398
R10	118	129	210	322	506	508	178	335	395	559	214	148	2734
Maxim.	175	174	324	417	639	697	247	358	525	662	227	205	2921
PET	97	101	127	130	138	136	145	136	117	115	97	97	1435
R75/PET	0.35	0.17	0.19	0.52	0.98	0.69	0.53	1.09	1.58	1.91	0.93	0.53	1.16
DGP-75%	u	-	-	M	M	M	M	H	H	H	M	M	
Tmin	17.1	16.7	17.1	18.1	19.4	20.0	20.0	20.0	20.0	19.7	19.1	18.1	18.8
Tmean	21.8	21.7	22.1	23.0	23.8	24.4	24.7	25.0	24.6	24.3	23.6	22.6	23.5
Tmax	26.6	26.7	27.3	28.0	28.3	28.7	29.3	29.6	29.2	28.7	27.9	27.1	28.2

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Manchester Pastures [in %; data base: 1963 - 1983 , elev.= 397 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	19	39	43	13	2	8	2	1	1	1	2	13
P(.3<=X<.5)	29	12	11	12	5	5	23	0	0	0	5	0
P(.5<=Xi<1)	41	31	23	25	29	35	58	23	5	5	23	56
P(1<=Xi)	11	18	23	50	64	52	17	76	94	94	70	31
P(2<=Xi)	0	0	11	18	35	29	0	29	52	70	23	6
P(R> 25mm)	82	62	76	100	100	100	100	100	100	100	100	87
P(R> 50mm)	52	50	52	81	94	94	100	100	100	100	94	81
P(R> 75mm)	29	18	41	68	88	88	76	94	94	100	76	56
P(R>100mm)	11	18	23	56	82	64	52	88	94	94	70	31
P(R>150mm)	5	12	17	37	64	47	17	64	88	94	29	6
P(R>200mm)	0	0	11	25	58	35	5	58	76	82	17	6
P(R>300mm)	0	0	5	18	35	29	0	23	23	47	0	0
P(R>400mm)	0	0	0	12	17	17	0	0	5	29	0	0
P(R>500mm)	0	0	0	0	11	17	0	0	5	17	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Mandeville

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Mandeville (in mm/month and degrees Celsius respectively) [data base: 1951 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	28	30	30	29	29	30	29	28	27	30	30	30	25
Mean	63	59	97	160	234	209	115	190	248	317	116	73	1867
CV (%)	73	100	73	71	71	81	46	54	39	53	49	60	23
Minim.	9	0	5	20	22	15	39	20	123	64	17	17	1034
R90	10	5	6	29	42	0	51	60	115	119	38	13	1259
R75	30	20	46	79	116	89	77	116	179	198	76	42	1551
R50	58	47	94	149	217	203	111	185	248	300	116	73	1867
R25	91	86	145	230	336	323	149	259	317	419	157	104	2182
R10	124	131	193	313	458	439	188	331	380	542	195	132	2474
Maxim.	181	298	311	482	642	613	289	476	462	869	223	167	2703
PET	92	94	117	120	129	128	137	129	112	109	91	92	1350
R75/PET	0.32	0.21	0.39	0.66	0.89	0.69	0.56	0.89	1.60	1.81	0.83	0.45	1.14
DGP-75%	p	-	p	M	M	M	M	M	H	H	M	u	
Tmin	16.0	15.5	15.9	16.9	18.2	18.8	18.8	18.8	18.8	18.5	17.9	16.9	17.6
Tmean	20.6	20.4	21.0	21.8	22.6	23.1	23.5	23.8	23.4	23.0	22.3	21.3	22.2
Tmax	25.2	25.4	26.1	26.8	27.1	27.5	28.1	28.5	27.9	27.3	26.6	25.7	27.0

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Mandeville [in %; data base: 1951 - 1980 , elev.= 627 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	26	24	21	12	8	18	5	4	0	0	5	11
P(.3<=X<.5)	21	33	20	6	0	0	13	0	0	0	6	23
P(.5<=Xi<1)	28	23	23	31	20	26	65	25	0	10	33	36
P(1<=Xi)	25	20	36	51	72	56	17	71	100	90	56	30
P(2<=Xi)	0	3	3	17	27	36	3	17	48	73	16	0
P(R> 25mm)	78	80	83	96	96	93	100	96	100	100	96	90
P(R> 50mm)	50	43	70	86	93	83	93	96	100	100	90	63
P(R> 75mm)	28	23	53	75	93	76	75	96	100	96	70	36
P(R>100mm)	17	16	43	62	86	66	58	78	100	90	53	30
P(R>150mm)	7	6	23	41	62	50	13	71	88	90	23	6
P(R>200mm)	0	3	6	27	37	40	6	28	59	80	13	0
P(R>300mm)	0	0	3	13	27	26	0	14	22	46	0	0
P(R>400mm)	0	0	0	6	20	16	0	7	14	13	0	0
P(R>500mm)	0	0	0	0	10	10	0	0	0	10	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Marshall's Pen (in mm/month and degrees Celsius respectively) [data base: 1951 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	28	28	27	28	29	30	30	29	29	29	29	29	27
Mean	56	57	115	185	211	208	116	184	259	340	112	81	1922
CV (%)	72	68	71	52	58	74	55	51	40	42	57	64	20
Minim.	0	2	0	25	20	18	35	54	92	114	28	17	1147
R90	9	4	3	52	42	31	36	72	117	167	25	14	1392
R75	27	29	57	116	123	98	70	117	185	239	67	44	1647
R50	52	57	115	185	211	192	112	175	259	329	112	79	1922
R25	81	84	174	255	299	303	158	242	332	430	158	116	2196
R10	111	110	228	318	379	417	202	312	400	532	199	151	2451
Maxim.	199	145	308	389	480	636	273	473	490	761	250	204	2785
PET	91	92	114	117	126	126	134	127	110	107	89	90	1323
R75/PET	0.29	0.31	0.49	0.99	0.97	0.77	0.52	0.92	1.68	2.23	0.75	0.48	1.24
DGP-75%	-	p	p	M	M	M	M	M	H	H	M	u	
Tmin	15.6	15.1	15.5	16.5	17.8	18.4	18.4	18.5	18.4	18.2	17.5	16.6	17.2
Tmean	20.2	20.0	20.6	21.5	22.2	22.7	23.1	23.4	23.0	22.6	21.9	20.9	21.8
Tmax	24.8	24.9	25.7	26.4	26.7	27.1	27.7	28.1	27.6	26.9	26.2	25.3	26.6

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Marshall's Pen [in %; data base: 1951 - 1980 , elev.= 700 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	29	27	24	5	8	8	8	2	1	0	1	8
P(.3<=X<.5)	7	17	3	10	0	6	16	3	0	0	17	13
P(.5<=Xi<1)	50	39	29	7	20	23	50	27	3	0	20	48
P(1<=Xi)	14	17	44	78	72	63	26	68	96	100	62	31
P(2<=Xi)	3	0	11	25	34	33	6	10	48	82	17	6
P(R> 25mm)	75	78	88	96	96	96	100	100	100	100	100	93
P(R> 50mm)	53	57	74	89	93	86	80	100	100	100	82	62
P(R> 75mm)	21	25	66	82	86	83	66	89	100	100	68	34
P(R>100mm)	10	14	55	78	75	80	56	82	96	100	48	31
P(R>150mm)	3	0	29	60	58	53	23	58	93	96	24	17
P(R>200mm)	0	0	11	35	44	36	10	37	65	86	13	3
P(R>300mm)	0	0	3	14	27	23	0	6	31	55	0	0
P(R>400mm)	0	0	0	0	13	13	0	6	17	20	0	0
P(R>500mm)	0	0	0	0	0	6	0	0	0	13	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Mile Gully

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Mile Gully (in mm/month and degrees Celsius respectively) [data base: 1951 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	30	29	29	30	29	30	29	27	30	27	28	25	21
Mean	58	58	102	189	251	145	102	178	211	260	103	63	1776
CV (%)	119	82	69	59	71	88	43	59	44	44	60	71	19
Minim.	0	2	1	50	26	11	39	73	12	81	26	12	1199
R90	5	10	10	60	7	27	47	75	83	106	32	13	1298
R75	17	26	51	110	124	62	71	110	145	177	59	31	1527
R50	40	50	100	177	251	120	100	160	211	257	96	57	1776
R25	80	82	151	257	378	202	131	226	278	340	140	89	2025
R10	135	119	200	340	495	301	162	305	340	418	185	124	2254
Maxim.	356	263	301	569	709	626	246	590	394	540	297	187	2466
PET	91	93	115	118	126	127	135	128	110	108	89	90	1330
R75/PET	0.18	0.27	0.44	0.93	0.98	0.49	0.52	0.86	1.30	1.64	0.66	0.34	1.14
DGP-75%	-	-	p	M	M	u	M	M	H	H	M	u	
Tmin	16.5	16.1	16.5	17.5	18.8	19.4	19.4	19.4	19.4	19.2	18.5	17.5	18.2
Tmean	21.2	21.1	21.5	22.4	23.2	23.8	24.1	24.4	24.0	23.7	23.0	22.0	22.9
Tmax	25.9	26.0	26.7	27.4	27.7	28.1	28.7	29.1	28.6	28.0	27.3	26.4	27.6

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Mile Gully [in %; data base: 1951 - 1980 , elev.= 510 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	41	26	18	1	9	8	5	1	4	1	5	20
P(.3<=X<.5)	20	20	10	10	6	16	20	0	3	0	7	32
P(.5<=Xi<1)	23	44	41	16	20	40	55	33	10	7	42	20
P(1<=Xi)	16	10	31	73	65	36	20	66	83	92	46	28
P(2<=Xi)	3	3	6	26	41	16	0	11	50	55	10	4
P(R> 25mm)	60	75	86	100	100	93	100	100	96	100	100	84
P(R> 50mm)	30	51	75	96	89	90	89	100	93	100	78	48
P(R> 75mm)	20	27	62	86	79	70	68	92	90	100	57	32
P(R>100mm)	16	6	48	83	75	56	48	77	86	92	42	20
P(R>150mm)	6	3	20	56	65	33	6	48	70	88	17	8
P(R>200mm)	3	3	6	36	55	20	3	33	53	66	10	0
P(R>300mm)	3	0	3	13	37	6	0	7	13	22	0	0
P(R>400mm)	0	0	0	6	24	6	0	3	0	14	0	0
P(R>500mm)	0	0	0	3	10	3	0	3	0	3	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

New Port

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for New Port (in mm/month and degrees Celsius respectively) [data base: 1951 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	30	26	29	30	28	27	27	27	29	28	26	28	20
Mean	66	40	69	94	182	168	94	169	234	288	108	67	1579
CV (%)	62	78	68	75	63	81	73	52	77	45	59	62	24
Minim.	13	0	15	8	8	12	6	53	69	49	7	11	966
R90	15	0	16	24	38	14	6	47	81	109	19	10	1046
R75	37	17	36	47	98	70	45	106	127	195	62	37	1301
R50	64	39	63	82	175	152	92	169	200	288	108	67	1579
R25	94	61	97	129	259	251	141	232	301	382	155	96	1856
R10	123	83	132	184	341	355	189	291	428	468	198	123	2112
Maxim.	186	118	221	375	525	504	258	360	952	603	261	170	2564
PET	90	91	113	115	124	125	133	126	109	106	88	89	1311
R75/PET	0.40	0.18	0.31	0.40	0.79	0.55	0.33	0.83	1.16	1.83	0.70	0.41	0.99
DGP-75%	p	-	p	p	M	M	u	M	H	H	M	u	
Tmin	15.4	15.0	15.4	16.3	17.6	18.3	18.2	18.3	18.2	18.0	17.4	16.4	17.1
Tmean	20.0	19.9	20.4	21.3	22.1	22.6	22.9	23.2	22.9	22.4	21.7	20.7	21.7
Tmax	24.6	24.7	25.5	26.3	26.5	26.9	27.6	28.0	27.4	26.7	26.0	25.1	26.4

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at New Port [in %; data base: 1951 - 1980 , elev.= 731 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	15	44	26	7	8	13	27	2	1	1	13	23
P(.3<=X<.5)	33	19	20	33	0	14	18	3	0	3	0	14
P(.5<=Xi<1)	26	30	37	40	21	25	33	40	13	0	26	35
P(1<=Xi)	26	7	17	20	71	48	22	55	86	96	61	28
P(2<=Xi)	3	0	0	6	28	22	0	25	31	64	15	0
P(R> 25mm)	86	57	86	93	96	92	88	100	100	100	88	85
P(R> 50mm)	50	30	55	80	92	85	70	100	100	96	84	57
P(R> 75mm)	30	11	34	53	82	70	51	92	96	96	65	35
P(R>100mm)	26	7	20	36	78	59	33	77	89	96	50	25
P(R>150mm)	3	0	6	10	46	40	22	44	65	89	19	3
P(R>200mm)	0	0	3	6	28	29	14	29	41	64	11	0
P(R>300mm)	0	0	0	3	21	18	0	11	20	46	0	0
P(R>400mm)	0	0	0	0	3	11	0	0	10	17	0	0
P(R>500mm)	0	0	0	0	3	3	0	0	6	7	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Porus

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Porus (in mm/month and degrees Celsius respectively) [data base: 1948 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	23	25	27	27	25	24	26	28	24	22	22	22	12
Mean	64	55	67	122	278	204	115	173	249	285	127	76	1813
CV (%)	86	110	84	88	74	91	50	50	62	58	59	73	24
Minim.	15	5	1	11	26	23	25	39	52	47	30	20	1097
R90	16	7	4	16	64	23	41	55	79	99	46	22	1173
R75	29	18	27	49	137	77	74	111	141	168	74	39	1480
R50	51	40	61	102	247	169	112	173	228	264	116	65	1813
R25	84	76	101	176	387	297	154	235	336	381	168	101	2146
R10	129	125	145	262	546	448	195	291	454	509	227	145	2453
Maxim.	217	309	215	534	994	653	283	355	758	884	381	262	2491
PET	106	112	143	147	155	149	158	147	127	125	107	106	1582
R75/PET	0.27	0.16	0.18	0.33	0.88	0.51	0.46	0.75	1.11	1.34	0.69	0.36	0.93
DGP-75%	-	-	-	p	M	M	u	M	H	H	M	u	
Tmin	18.4	18.0	18.5	19.4	20.8	21.4	21.4	21.4	21.4	21.1	20.5	19.5	20.2
Tmean	23.2	23.1	23.5	24.4	25.2	25.8	26.1	26.4	26.0	25.8	25.1	24.1	24.9
Tmax	28.2	28.3	28.8	29.4	29.7	30.2	30.7	31.0	30.6	30.2	29.5	28.7	29.6

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Porus [in %; data base: 1948 - 1980 , elev.= 132 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	32	48	45	27	4	6	9	5	1	1	6	11
P(.3<=X<.5)	21	4	22	11	4	29	19	7	4	4	4	31
P(.5<=Xi<1)	34	40	22	33	16	20	53	35	12	9	45	36
P(1<=Xi)	13	8	11	29	76	45	19	53	83	86	45	22
P(2<=Xi)	8	4	0	3	32	20	0	14	33	54	13	4
P(R> 25mm)	78	60	81	85	100	95	100	100	100	100	100	90
P(R> 50mm)	47	48	51	74	96	87	92	92	100	95	95	59
P(R> 75mm)	21	16	33	62	92	66	73	89	91	95	81	36
P(R>100mm)	13	8	22	48	88	66	61	75	91	95	50	22
P(R>150mm)	8	4	11	25	76	45	19	53	70	86	31	9
P(R>200mm)	8	4	7	14	52	33	11	39	58	77	13	4
P(R>300mm)	0	4	0	3	40	20	0	10	25	36	4	0
P(R>400mm)	0	0	0	3	12	16	0	0	12	13	0	0
P(R>500mm)	0	0	0	3	12	12	0	0	8	4	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Spur Tree H.E.

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Spur Tree H.E. (in mm/month and degrees Celsius respectively) [data base: 1960 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	15	15	15	15	16	16	15	17	16	17	16	14	11
Mean	71	50	83	142	207	143	77	145	195	243	91	82	1532
CV (%)	78	69	79	60	84	70	65	45	48	47	69	59	24
Minim.	12	9	2	28	7	24	0	35	62	0	7	12	966
R90	7	1	0	21	11	23	6	52	75	81	8	13	984
R75	31	24	34	79	80	69	40	97	126	159	45	46	1247
R50	65	50	83	142	186	133	77	145	189	243	89	82	1532
R25	106	75	131	205	316	208	114	193	259	328	136	118	1818
R10	148	98	175	263	453	286	148	237	329	406	181	151	2081
Maxim.	194	112	202	302	669	425	200	256	461	582	234	176	2159
PET	90	91	113	115	124	125	133	126	109	106	87	89	1306
R75/PET	0.34	0.26	0.30	0.68	0.64	0.55	0.30	0.76	1.15	1.50	0.50	0.52	0.95
DGP-75%	u	-	p	M	M	M	u	M	H	H	M	M	
Tmin	15.4	14.9	15.3	16.3	17.5	18.2	18.1	18.2	18.2	17.9	17.3	16.3	17.0
Tmean	20.0	19.8	20.3	21.2	22.0	22.5	22.8	23.1	22.8	22.3	21.6	20.7	21.6
Tmax	24.5	24.7	25.5	26.2	26.4	26.8	27.5	27.9	27.3	26.6	25.9	25.0	26.3

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Spur Tree H.E. [in %; data base: 1960 - 1980 , elev.= 746 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	28	41	27	7	14	13	21	8	1	7	13	23
P(.3<=X<.5)	20	6	20	13	0	6	26	5	0	0	12	7
P(.5<=Xi<1)	26	33	20	20	18	31	33	29	18	5	25	35
P(1<=Xi)	26	20	33	60	68	50	20	58	81	88	50	35
P(2<=Xi)	6	0	0	26	25	18	0	5	37	76	18	0
P(R> 25mm)	73	60	80	100	87	93	86	100	100	94	87	85
P(R> 50mm)	53	53	53	80	87	87	73	88	100	94	68	71
P(R> 75mm)	26	20	46	73	75	68	40	82	93	88	62	57
P(R>100mm)	26	13	33	66	68	56	26	70	81	88	25	35
P(R>150mm)	20	0	20	33	50	43	6	41	62	88	18	14
P(R>200mm)	0	0	6	26	37	18	0	29	43	82	12	0
P(R>300mm)	0	0	0	6	18	6	0	0	12	11	0	0
P(R>400mm)	0	0	0	0	18	6	0	0	6	5	0	0
P(R>500mm)	0	0	0	0	6	0	0	0	0	5	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Tregeron

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Tregeron (in mm/month and degrees Celsius respectively) [data base: 1951 - 1972]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	18	16	18	18	18	17	18	19	18	18	17	18	16
Mean	58	66	90	167	262	258	124	160	267	327	129	79	1950
CV (%)	89	95	61	56	64	67	37	46	35	47	50	51	20
Minim.	15	3	5	38	60	38	50	54	141	91	57	28	1333
R90	13	4	12	33	38	11	59	60	137	129	56	22	1400
R75	25	22	50	98	139	131	91	107	198	214	84	49	1659
R50	46	54	90	167	257	258	124	158	266	317	121	79	1942
R25	77	99	130	236	381	385	158	212	335	431	167	108	2235
R10	119	154	167	300	501	505	190	263	402	547	219	136	2517
Maxim.	227	224	210	384	638	638	217	360	476	704	321	146	2749
PET	92	93	116	118	127	127	135	128	111	108	90	91	1334
R75/PET	0.27	0.23	0.42	0.82	1.09	1.02	0.67	0.83	1.78	1.98	0.93	0.54	1.24
DGP-75%	-	-	p	M	H	H	M	M	H	H	M	M	
Tmin	15.7	15.3	15.7	16.7	17.9	18.6	18.5	18.6	18.6	18.3	17.7	16.7	17.4
Tmean	20.4	20.2	20.7	21.6	22.4	22.9	23.2	23.5	23.2	22.8	22.1	21.1	22.0
Tmax	25.0	25.1	25.9	26.6	26.8	27.2	27.9	28.3	27.7	27.1	26.3	25.5	26.7

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Tregeron [in %; data base: 1951 - 1972 , elev.= 670 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	35	26	24	1	2	7	2	1	0	1	1	1
P(.3<=X<.5)	27	25	11	5	5	0	16	10	0	0	0	16
P(.5<=Xi<1)	22	37	38	33	16	23	38	21	0	5	35	50
P(1<=Xi)	16	12	27	61	77	70	44	68	100	94	64	33
P(2<=Xi)	5	12	0	16	38	41	0	10	55	88	11	0
P(R> 25mm)	66	75	83	100	100	100	100	100	100	100	100	100
P(R> 50mm)	38	50	66	94	100	94	100	100	100	100	100	66
P(R> 75mm)	22	25	61	83	94	88	77	89	100	100	82	44
P(R>100mm)	16	12	44	72	83	88	61	78	100	94	58	33
P(R>150mm)	5	12	11	44	72	52	33	42	94	88	29	0
P(R>200mm)	5	12	5	22	50	52	5	26	83	88	11	0
P(R>300mm)	0	0	0	16	27	41	0	5	27	50	5	0
P(R>400mm)	0	0	0	0	22	23	0	0	16	22	0	0
P(R>500mm)	0	0	0	0	16	11	0	0	0	11	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

Williamsfield

Table 1 : Extremes and variability of monthly and annual rainfall totals, mean potential evapo-transpiration, and mean air temperature for Williamsfield (in mm/month and degrees Celsius respectively) [data base: 1951 - 1980]

PERIOD	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
N	22	21	20	20	19	18	17	16	18	18	16	18	12
Mean	46	59	85	128	233	170	133	199	232	331	130	66	1858
CV (%)	86	80	68	65	91	80	59	42	39	42	37	66	23
Minim.	0	0	4	23	20	28	27	28	68	88	48	3	1156
R90	2	0	4	23	13	28	21	79	105	135	62	4	1234
R75	17	25	43	67	80	73	75	136	166	229	94	34	1533
R50	41	59	85	123	197	146	133	199	232	331	130	66	1858
R25	70	93	127	184	353	244	191	261	298	432	166	98	2182
R10	101	124	166	245	526	356	245	318	359	526	199	127	2481
Maxim.	175	188	196	359	831	597	320	348	433	651	210	144	2742
PET	97	101	127	130	138	136	145	136	118	115	97	97	1437
R75/PET	0.17	0.24	0.33	0.51	0.57	0.53	0.51	1.00	1.41	1.98	0.97	0.34	1.06
DGP-75%	-	-	p	M	M	M	M	H	H	H	M	u	
Tmin	17.1	16.7	17.1	18.1	19.4	20.0	20.0	20.1	20.1	19.8	19.1	18.2	18.8
Tmean	21.8	21.7	22.1	23.1	23.9	24.4	24.7	25.0	24.6	24.3	23.6	22.7	23.5
Tmax	26.6	26.7	27.4	28.0	28.3	28.8	29.4	29.7	29.2	28.7	28.0	27.1	28.2

Note: R75 is mm of rainfall surpassed in 75% of the years in specified period
DGP-75% is the dependable growing period in 75% of the years
PET and T are calculated using linear regression.

Table 2 : Probability of surpassing preselected monthly rainfall totals at Williamsfield [in %; data base: 1951 - 1980 , elev.= 392 m]

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
P(Xi<0.3)	37	39	25	10	17	18	13	7	1	1	1	35
P(.3<=X<.5)	18	9	10	20	10	5	23	0	0	0	6	5
P(.5<=Xi<1)	36	38	40	20	21	27	23	18	11	5	12	44
P(1<=Xi)	9	14	25	50	52	50	41	75	88	94	81	16
P(2<=Xi)	0	0	0	10	31	16	5	25	33	83	12	0
P(R> 25mm)	68	61	75	95	94	100	100	100	100	100	100	66
P(R> 50mm)	40	52	65	85	84	83	88	93	100	100	87	61
P(R> 75mm)	18	38	55	60	73	72	64	93	94	100	81	50
P(R>100mm)	9	19	35	60	63	61	58	93	88	94	81	16
P(R>150mm)	4	4	20	35	47	44	41	68	83	88	37	0
P(R>200mm)	0	0	0	15	36	33	23	50	61	88	6	0
P(R>300mm)	0	0	0	5	31	16	5	12	22	50	0	0
P(R>400mm)	0	0	0	0	21	5	0	0	5	22	0	0
P(R>500mm)	0	0	0	0	10	5	0	0	0	11	0	0

Note: frequency analysis of non-transformed data (for N see table 1)
Xi is the abbreviation for R/PET

APPENDIX II

Annual R75'/PET ratios and corresponding agro-climatic codes for 20 stations located in Manchester, St. Elizabeth, Clarendon and Trelawny.

Seventeen rainfall recording stations is somewhat low for drawing the agro-climatic zones map for Manchester. This density of observations can be increased in a simple manner using the linear relationship that was found to exist between annual dependable rainfall (R75') and mean annual totals (Rm) in Manchester:

(1) R75' = -177 + 0.933xRm (r-square= 0.984, N= 17)

R75' can now be computed from Rm using the list of mean annual rainfall issued by the Meteorological Service. As such, the tedious process of entering monthly rainfall data into the computer can be reduced. It is assumed that regression equation (1) can be applied safely to stations which border Manchester. In this context it should be observed that equation (1) is quite similar to the one found for the parishes of St. Catherine and Clarendon (SSU 1988a), i.e.:

(2) R75' = -139 + 0.900xRm (r-square= 0.976, N= 33)

PET and air temperature can be derived from elevation using linear regression functions (IICA 1983, SSU 1988a). In conjunction with equation (1) it is therefore possible to estimate the R75'/PET ratio and identify the thermal code for each rainfall recording station. On the basis of these figures each station can be assigned to a particular agro-climatic zone (see Table A).

The above technique was applied to 20 rainfall recording stations located in Manchester and neighboring St. Elizabeth, Trelawny and Clarendon, viz. (see Figure 1):

- Manchester (9): Auchtembie, Devon, Coleyville, Walderston, Victoria Town, Hermitage, Cross Keys, Knock Patrick, Old England.
- St. Elizabeth (5): Balaclava, Bull Savanna, Nain, Myersville and Santa Cruz
- Trelawny (3): Troy, Wait-A-Bit and Warsop.
- Clarendon (3): Clarendon Park, Mocho and Springfield.

Map correlation towards Clarendon is further based on climatic statistics for Milk Spring, Thompson Town and Spaldings (SSU 1988b). The rating system in that study differs slightly from the present one (see section 5.1).

Table A: Annual R75'/PET ratios calculated with linear regression and corresponding agro-climatic codes for 20 recording stations in Manchester, St. Elizabeth, Trelwany and Clarendon.

Station	Rmean	R75'	R75'/PET	agro-climatic code
Springfield	917	678	0.44	D2a
Victoria Town	971	728	0.51	I1a
Cross Keys	1074	825	0.53	I1b
Bull Savanna	1049	802	0.55	I1a
Myersville	1372	1103	0.74	I1a
Hermitage	1349	1082	0.78	I2b
Nain	1551	1270	0.84	I2a
Clarendon Park	1735	1442	0.91	I2a
Walderston	1656	1368	1.06	W1c
Old England	1783	1487	1.10	W1c
Knock Patrick	1770	1474	1.12	W1c
Santa Cruz	2078	1762	1.13	W1a
Mocho	1940	1633	1.15	W1b
Devon	1824	1567	1.19	W1c
Coleyville	1869	1567	1.20	W1c
Auchtembie	2077	1761	1.22	W1b
Balaclava	2496	2152	1.45	W2a
Wait-A-Bit	2217	1891	1.47	W2c
Warsop	2304	1973	1.48	W2c
Troy	2425	2085	1.49	W2b

List of publications issued by the Jamaica Soil Survey Project
(September 1989)

Soil Survey Reports

SR-1 (July 1986). Soil and land use survey of the Coastal Plain of St. Catherine. Jamaica (scale 1:50.000)
SR-2 (May 1987). Semi-detailed soil survey of the Linstead-Bog Walk area. St. Catherine. Jamaica (scale 1:25.000)
SR-3 (Feb. 1989). Semi-detailed soil survey of the Pedro area, St. Elizabeth, Jamaica (scale 1:25.000)
SR-4 (Aug. 1989). Semi-detailed soil survey of the Montpelier area. Western Jamaica (scale 1:25.000)

Technical Soils Bulletins

TB-1 (Nov. 1985). Legends for semi-detailed soil maps: the entries proposed for Jamaica (1st Approximation).
TB-2 (Dec. 1985. Assessment of the resistance of land to erosion for land evaluation.
TB-3 (Apr. 1986). Jamaica Physical Land Evaluation System (JAMPLES).
TB-4 (Aug. 1986). Methodology and BASIC programmes for the statistical analysis of rainfall probability.
TB-5 (Sep. 1986). Matching model (MATMOD), Jamaica Physical Land Evaluation System.
TB-6 (Sep. 1986). General temperature zones for land evaluation in Jamaica.
TB-7 (Apr. 1987). CROPRISK, a computerized procedure to assess the agro-ecological suitability of land for rainfed annual crops.
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TB-9 (Dec. 1986). A semi-detailed soil legend: a framework for Jamaica (2nd Approximation).
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TB-12 (July 1988). Soil Legend Framework for Jamaica (3rd Approximation).
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TB-15 (Feb. 1989). Matching of land use requirements with land qualities using the computerized land evaluation module.
TB-16 (July 1989). User's Guide to the Jamaica Physical Land Evaluation System (Vesrion 3.0).

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MP-5 (Feb. 1988). The application of transfer-functions in creating the climate data base of the Jamaica Geographical Information System (JAMGIS).
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MP-8 (Sep. 1989). Agro-climatic zones of the parish of Manchester. Jamaica.