Chapter IV

RAINFALL CHARACTERISTICS

INTRODUCTION

This chapter deals with the assessment and analysis of the rainfall amount, the pattern etc. of the Rakti River Basin to predict the exact nature of the rainfall which plays important role in shaping the hydrological, erosional & agricultural characteristics of the Basin as explained in the subsequent chapters.

A. RAINFALL ANALYSIS

For the analysis of the rainfall characteristics of the Basin under study the rainfall data of the nine stations have been collected from different areas, seven of which fall within the Basin and two others just outside the Basin boundary. These two rain-gauge stations falling outside the Basin have been considered to cover up the whole Basin area with evenly distributed rain-gauges as much as possible. Moreover, the rain-gauge stations which are available within the Basin area are not sufficient for the analysis of rainfall characteristics since these gauges were not covering the each and every corners of the Basin area. Therefore, two more rain-gauges adjacent to the Basin boundary have been chosen for the purpose of filling up the gaps also.

The rainfall data are not available for equal no. of years in all the stations as will be revealed from the following description of station names & data lengths . (1) Putinbari Tea Estate (14 years) (2) Fulbari Tea Estate (28 years) (3) Simulbari Tea Estate (30 years) (4) Marionbari Tea Estate (19 years), (5) Longview Tea Estate (27 years), (6) Gayabari Tea Estate (30 years), (7) Gourisankar (Castleton) Tea Estate (19 years), (8) I.O.W. Kurseong (22 years) and Singell Tea Estate (29 years).

The data for all these stations have been processed & analysed for predicting the distribution and the pattern of the mean annual rainfall depth, variability (annual and monsoonal) persistence, trend and their interrelationships so that the exact picture of the rainfall characteristics of the Basin under study can be easily perceived. The methodology follows the standard quantitative techniques formulated by different experts (Reed & Kincer 1917, Linsley et al. 1949, Dawdy & Matalas 1964, De Wiest 1965, Barry 1969, Von Lengerke 1977, Biswas & Maske 1981).

a. Average Depth of Annual Rainfall

By average depth of rainfall we mean the average amount of rainfall accumulated over an area. Several methods are used to calculate the average depth of rainfall over an area. In order to analyse the average depth of annual rainfall over the Rakti Basin area, the Isohyetal method has been chosen, since the Basin under study has got sufficient orographic effect being characterised by both hills and plains (Linsley et.al. 1949). The point rainfall (on mean annual basis) as calculated from different rain-gauges have been used to compute the average depth of annual precipitation of a specific area of the Basin. Finally, on the basis of the point values of various stations, the isohyetes have been drawn to find out zones having different ranges of mean annual rainfall depth of the Basin. The average value of each zone is, then, determined by computing the mean value of the incremental amount between each pair of isohyetes encompassing a particular zone. The individual average depth of annual rainfall of different zones have further been weighted by the respective areas occupied by them and the total of their weighted values has been divided by the total area of the Basin to get the average annual rainfall of the whole Basin area. Thus, the average annual precipitation of the Basin may be explained as : $\frac{\text{Pave x A}}{\text{Ad.}}$

Where Pave = Average precipitation in m.m.
A = Area in sq.km. of an individual zone of the Basin
Ad = Total area of the Basin in sq.km.

The individual zones of annual rainfall depth having different areas (in sq.km.) and the average annual rainfall of the Rakti Basin are given in the Table IV.1 below.

Table IV.1

Rainfall depth zones with respective areas

Depth Zones	Area in sq.km. A	Average precipitation PAVE (m.m)	PAVE x A
I	1.90	2945.00	5595.5
II	1.50	3250.00	4875.00
III	4.30	3750.00	16125.00
IV	2.10	3931.30	8255.70
V	0.60	4154.40	2492.60
VI	26.40	4250.00	112200.00
VII	27.80	4750.00	132050.00
VIII	0.40	5061.50	2024.60

Ad = 65.00 sq.km. ΣPAVE x A = 283618.40

Ave. Precipitation of the Basin = $\frac{\text{PAVE x A}}{\text{Ad.}}$ = 4363.40 m.m

From the table IV.1 it becomes apparent that the Rakti River Basin is consisted of eight average annual rainfall depth zones ranging from 2945.00 mm. to 5061.00 m.m.

However, these zones have been further categorised for convenience as in the Table IV.2 below.

Table IV.2

Rainfall depth zones falling in different categories

Depth Zones	Average ppt in mm.	Categories
I	2945.00	Low
II	3250.00	
III	3750.00	Mod. Low
IV	3931.30	Moderate
V	4154.40	
VI	4250.00	
VII	4750.00	High
VIII	5061.50	Very High

The Fig.IV.1 showing the annual rainfall depth zones of the Basin under study depicts that both the northern and southern parts belonging to hills with highest altitude & plains with the lowest altitude respectively get lower amount of average annual rainfall in comparison to the middle part of the Basin which is characterised mainly by foot-hills and upper part of terai slopy plain. Again between the hilly portion having the highest altitude and the plain portion of the lowest altitude of the Basin, the hill receives higher average annual rainfall (ranging from 3931.30 m.m. to 4154.40 m.m i.e., moderate) as compared to the plain (2945.00 m.m. to 3750.00 m.m i.e., low to mod. low). The highest average annual rainfall depth zone of 5061.5 m.m occures nearly in the centre of the Basin i.e., at Simulbari Tea Garden area which is followed by the gradually decreasing rainfall depth zones towards both the north and south. The geographical distribution of the different categories of rainfall depths are as follows :

i) <u>The Low Rainfall Depth of 2945.00 m.m & 3250.00 m.m</u> of rainfall is seen to occur on the extreme southern portion having almost flat surface of the terai plain area of the Basin.

ii) <u>The Moderately Low Rainfall Depth having 3750.00 m.m</u> occupies a narrow strip of land extended NW-SE above the low depth zones.

iii) <u>The Moderate Rainfall Depth encompassing zones of 3931.00 m.m 4154.00 m.m & 4250.00 m.m</u> covers both the plain of relatively flat surface as well as the entire middle hill area of relatively higher altitude of the Basin.

iv) <u>The High Rainfall Depth having 4750.00 m.m</u> of precipitation occupies the comperatively steep northern terai plain & the entire foothill area of the Basin.

v) <u>The Very High Rainfall depth having 5061.00 m.m</u> of rainfall is confined to a very small area on the northern slopy terai plain within the high depth zone.

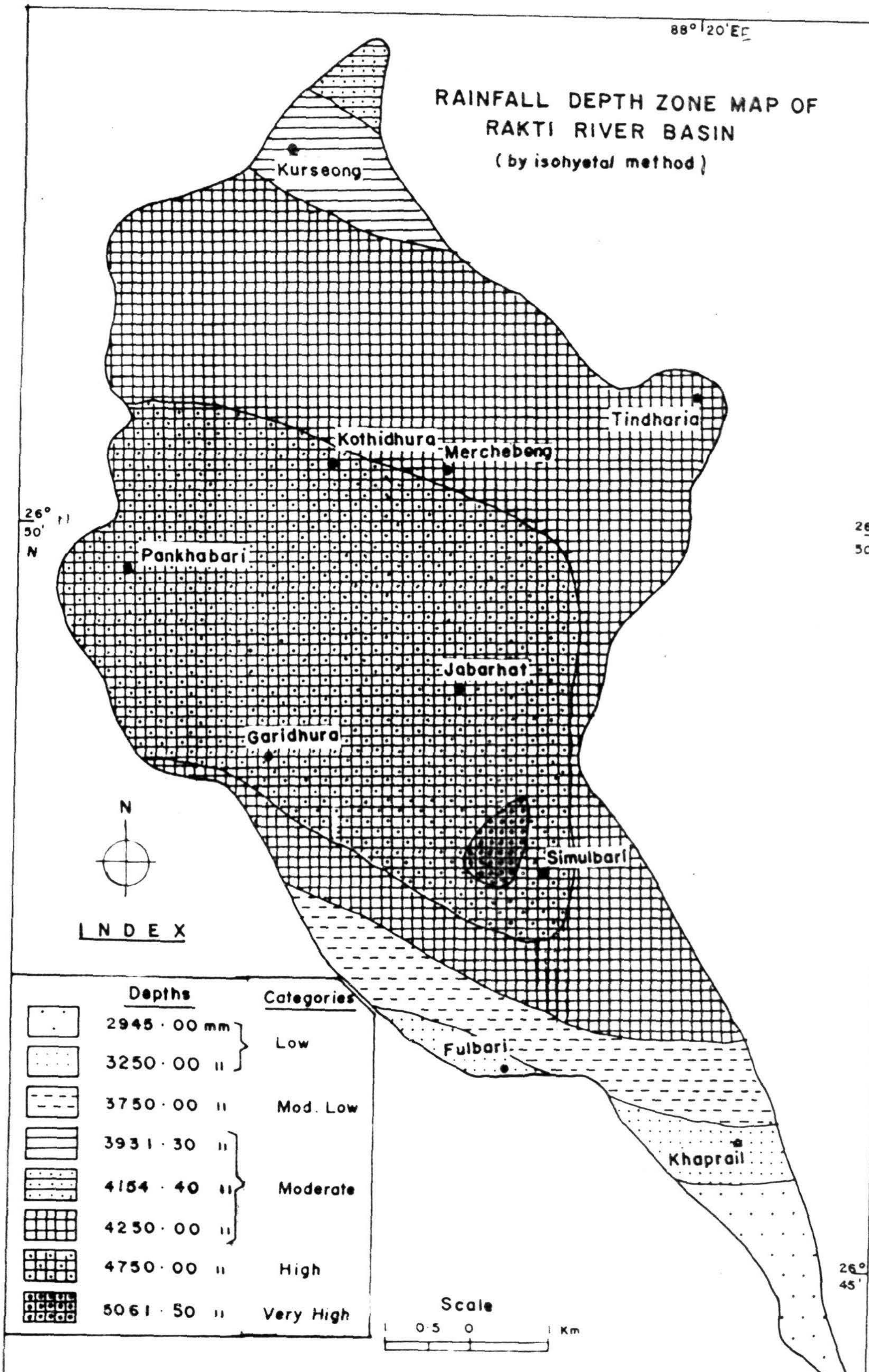

RAINFALL DEPTH ZONE MAP OF
RAKTI RIVER BASIN
(by isohyetal method)
88° 20' E
26° 50' N
26° 50'
26° 45'
88° 20'
Kurseong
Tindharia
Kothidhura
Merchebong
Pankhabari
Jabarhat
Garidhura
Simulbari
Fulbari
Khaprail
N
INDEX
Depths
Categories
2945 · 00 mm
3250 · 00 "
Low
3750 · 00 "
Mod. Low
3931 · 30 "
4154 · 40 "
4250 · 00 "
Moderate
4750 · 00 "
High
5061 · 50 "
Very High
Scale
1 0·5 0 1 Km

Fig — IV·1

Regarding the areal distribution of different rainfall depth zones it is apparent that the annual average depth zone of 4750.00 m.m (i.e., high depth zone) occupies the largest part of the Basin under study i.e., 42.77% or 27.8 sq.km out of 65 sq.km of the total Basin area. This zone encircles the small area of only 0.40 sq.km. having the highest average annual rainfall depth zone of the Basin under study. The average annual precipitation zone of 4250.00 falling within moderate depth also occupies a remarkable portion of the Basin under study i.e., 40.62% or 26.40 sq.km of the total Basin. So both the moderate (4250.00 m.m) & high (4750.00 m.m) rainfall depth zones occupy the most part of the Basin under study.

From the view point of the rainfall-depth pattern & its areal distribution in the Basin the following conclusions may be drawn :

1. The occurrence of high & very high rainfall depth zones covering northern terai plain & the entire foot-hill region of the Basin clearly reveals that the in-coming monsoonal wind colliding with the rising slopes of the foot-hills of the Basin releases its maximum moisture as a form of rain over that entire region. Thus, the next reach of higher altitude above 800 mt. a.m.s.l. belonging to middle hill topography, receives relatively lower amount of precipitation in comparison to its lower part, & thereby depicts lower amount of rainfall depths.

2. Since the moisture bearing wind gets no orographic obstruction over the plain area sufficiently away from the foot-hill zones, the extreme southern plain portion of the Basin receives the lowest amount of rainfall in comparison to other parts.

3. The pattern of the rainfall depth in the Basin is not haphazard. It has a sequential rise towards the middle part of the Basin encompassing the Sub-Himalayan topographic region.

4. The largest area (84%) of the Basin receives the maximum

amount of rainfall & a rather small area consists of low supply of rain.

5. The resultant zones of higher rainfall depth reflect some distinct features of the Basin :

(a) It is observed that the areas which receive maximum amount of rainfall, usually undergo through typical rain splash effect on the upper layer of the soil. Thus the areas belonging to both the foot-hills & the northern portion of the rolling plains have been characterised by typical erosion of soil specially in the Tea-Garden areas where soils are found to be loose and uncompacted. (b) The Simulbari tea garden area having the highest rainfall depth zone (as described above) has given rise to a small perennial tributary namely Salai Jhora which contributes water to the Rakti channel (flowing through the lower portion of plain) even in the dry season when the upper portion upto the foot-hills is found to be dry. Thus, the very high amount of rainfall in Simulbari area facilitates continuous supply of water in the lower Rakti channel when the whole upper segment above Simulbari suffers acutely from the paucity of water.

6. The average annual rainfall depth of the Basin as a whole has been calculated to be 4363.40 m.m which is to some extent higher than the amount of 4097.70 m.m calculated by adding the twelve months mean values of rainfall of the Basin as described in climatic section of Chapter I. This variation is probably due to the weighting of the each zone of rainfall depths with their respective area as explained above.

b. Variability of Rainfall

The relative difference in coefficient of variations (CV in %) about the mean values of rainfall of particular period is called the variability of rainfall of an area. The pattern of variability of rainfall of an area is of utmost importance as it brings out the dormant characteristics of rainfall highly responsible for shaping the physical as well as cultural aspects of that particular area. The landform configurations as well as the agricultural productions, all are to a great extent dependent upon the annual & monsoonal rainfall variabilities. Therefore, both the annual and monsoonal variabilities of rainfall have been analysed for the Rakti River Basin under study. Since 80% of rain in Indian rainfall phenomena is accounted from the S.W. monsoon (Jun-Sep), the monsoonal variability as well as the annual variability have been taken into consideration. The mean, the standard deviation in m.m. and the coefficient of variation in percentage of annual as well as monsoonal rainfall of the nine rain-gauge stations over the Basin under study are given in the Table IV.3 below :

Table IV.3

Different statistical parameters of annual & monsoonal rainfall

Name of the Rain-gauge Stations	Altitude in mts. a.m.s.l	Annual Rainfall			Monsoonal Rainfall		
		Mean in m.m. $\bar{X}$	S.D. in m.m S	C.V. in % CV	Mean in m.m. $\bar{X}$	S.D. in m.m S	C.V. in % CV
Putinbari Tea Estate	160.00	2890.00	497.70	17.22	2408.70	392.90	16.31
Fulbari Tea Estate	180.00	3351.60	609.40	18.18	2776.00	508.10	18.30
Simulbari Tea Estate	220.00	5123.50	835.90	16.32	4185.40	709.30	16.95
Marionbari Tea Estate	240.00	4424.60	878.20	19.85	2965.7	940.20	31.70
Longview Tea Estate	420.00	4965.80	1137.00	22.89	4213.40	1208.30	28.68
Gayabari Tea Estate	880.00	4023.10	662.80	16.47	3289.40	516.40	15.70

contd ...

Table IV.3 contd ...

Gourisankar (Castleton) Tea Estate	1360.00	4079.70	623.30	15.28	3451.60	454.60	13.17
I.O.W. Kurseong	1480.00	3862.60	519.30	13.44	3232.50	532.10	16.46
Singell Tea Estate	1340.00	4308.80	664.50	15.42	3665.90	599.40	16.35

Station rainfall CVs have been used to draw isopleths of equal percentages of coefficient of variation of both the annual and monsoonal rainfall to prepare the variability maps of the Basin under study in Figure IV.2 and IV.3.

From the table IV.3 above it is observed that the range of the CVs of annual rainfall is 13.44 to 22.89% and for monsoonal CVs vary from 13.17 to 31.70%. Thus, the monsoonal variability of the Basin under study is higher than that of the annual variability. Regarding the pattern of variability of annual

Table IV.4

(a)

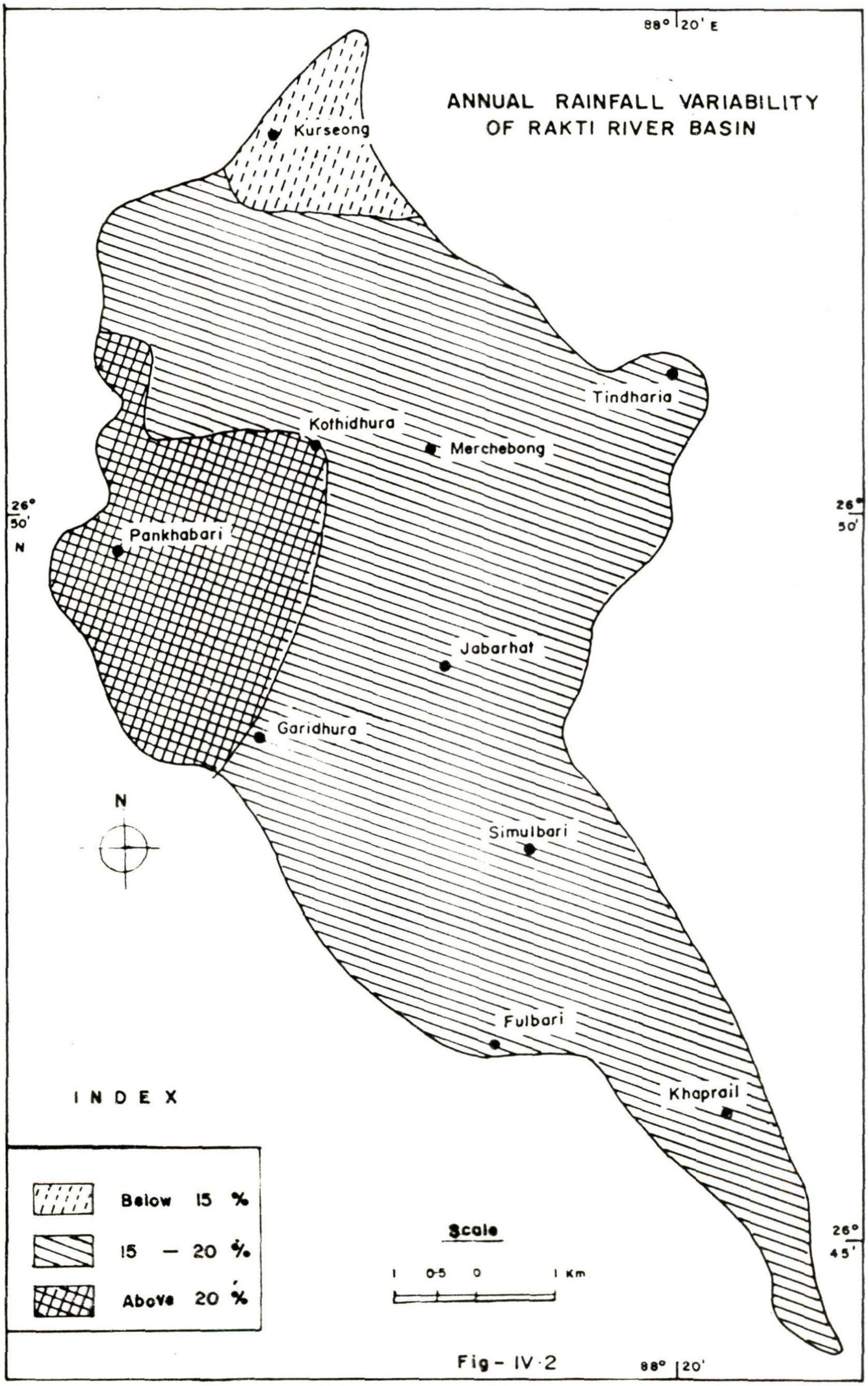
Different zones of annual rainfall variability

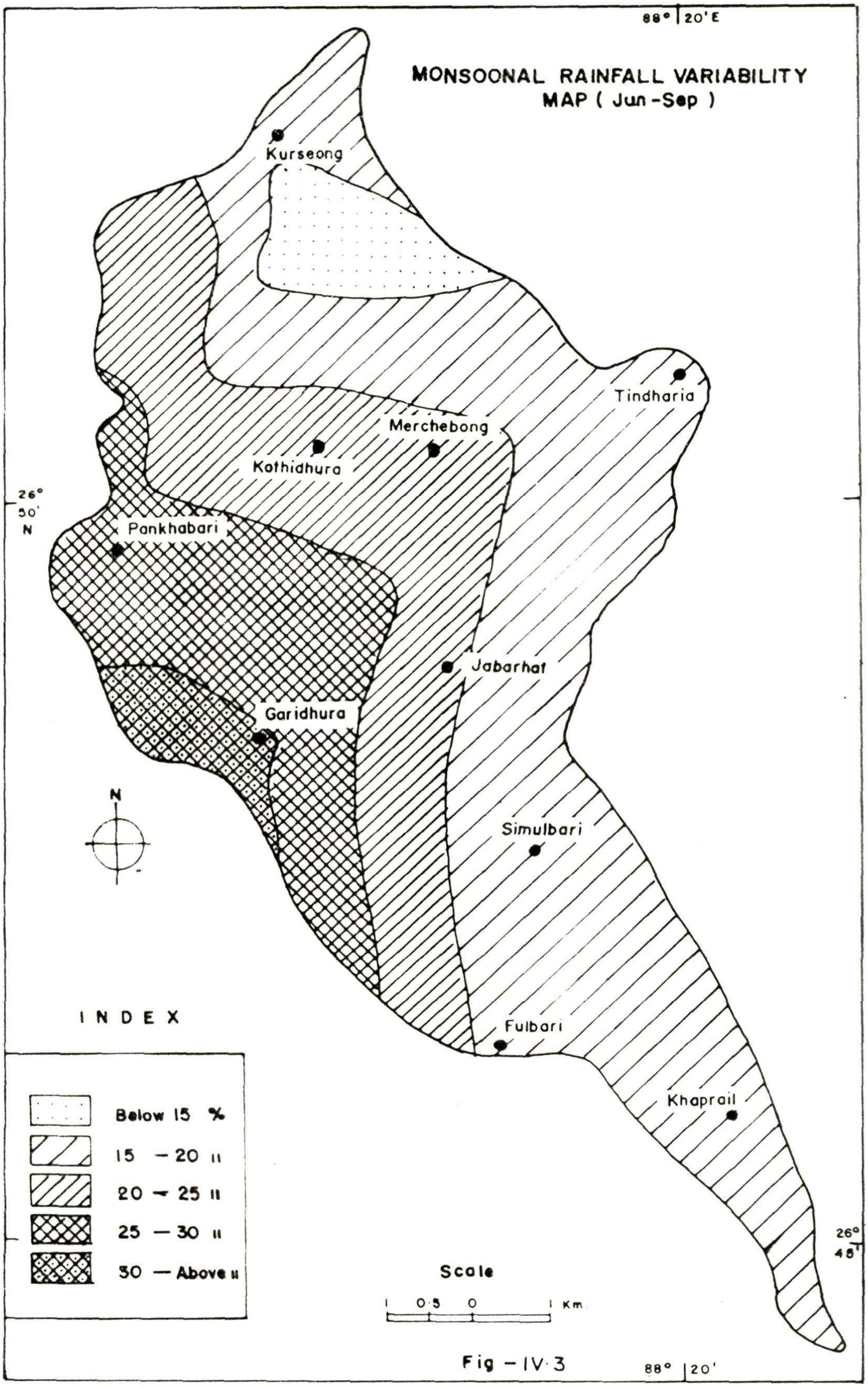
Sl. No.	Diff. categories of variability in %	Area obtained by different categories in sq. km.	% of area obtained by different categories
I	Below 15	2.75	4.23
II	15 - 20	51.31	78.94
III	Above 20	10.94	16.83
	Total	65.00	100.00

(b)

Different zones of monsoonal rainfall variability

Sl. No.	Diff. categories of variability in %	Area obtained by different categories in sq. km.	% of area obtained by different categories
I	Below 15	3.50	5.39
II	15 - 20	29.68	45.66
III	20 - 25	17.38	26.74
IV	25 - 30	12.13	18.66
V	Above 30	2.31	3.55
	Total	65.00	100.00


ANNUAL RAINFALL VARIABILITY
OF RAKTI RIVER BASIN
88° 20' E
Kurseong
Tindharia
Kothidhura
Merchebong
26° 50' N
26° 50'
Pankhabari
Jabarhat
Garidhura
N
Simulbari
Fulbari
Khaprail
INDEX
Below 15 %
15 — 20 %
Above 20 %
Scale
1 0·5 0 1 Km
26° 45'
88° 20'
Fig - IV·2



MONSOONAL RAINFALL VARIABILITY
MAP (Jun-Sep)
88° 20'E
Kurseong
Tindharia
Merchebong
Kothidhura
26°
50'
N
Pankhabari
Jabarhat
Garidhura
N
Simulbari
INDEX
Fulbari
Khaprail
Below 15 %
15 — 20 "
20 — 25 "
25 — 30 "
30 — Above "
26°
48'
Scale
1 0.5 0 1 Km
88° 20'

Fig — IV.3

rainfall it is found in Fig.IV.2 and Table IV.4(a) that the whole Basin area is constituted of three distinct variability zones at a 5 per cent difference in co-efficient of variation. The lowest variability of annual rainfall is seen to occur on the top northern portion of the Basin where the highest one on the western portion of the Basin comprised of foot-hills and wavy terai plains. The areal distribution of the variability of annual rainfall of the Basin depicts that the CVs between 15 to 20% occupy the largest area of 51.31 sq.km. i.e., 78.94% of the total Basin area.

The variability pattern of monsoonal rainfall of the Basin under study is more wide spread than that of the annual one. The Fig.IV.3 and Table IV.4(b) show that the whole Basin area depicts five distinct zones of monsoonal rainfall variability at 5% difference in co-efficient of variation. The highest one which is above 30% is found in the west being confined in a small area belonging to slopy terai plain of the Basin under study, where the lowest one (below 15%) in the top north-east portion in a small zone composed of hilly terrain. The most noticeable feature regarding the distribution of the monsoonal rainfall variability is that it gradually decreases from the west to the east of the Basin.

About the areal distribution of the monsoonal variability it is found that among the different categories of variability the largest area i.e., 29.68 sq.km. of the Basin is occupied by the variability zone of 15 to 20% which is 45.66% of the total area of the Basin under study. The next two categories of monsoonal variability i.e., 20-25% and 25-30% also occupy considerable areas of the Basin 17.38 sq.km. & 12.13 sq.km. which are 26.74% and 18.66% respectively of the total Basin area.

From the ranges, patterns and distributions of the annual as well as monsoonal variabilities of rainfall of the Basin under study, the following conclusions may be drawn :

1. Since the monsoonal variability of the Basin under study is higher (i.e., 31.70%) than that of annual variability (22.89%), the consistency of annual rainfall is certainly higher than that of seasonal or monsoonal one.

2. The range of variation in annual rainfall variability is shorter (9.49%) than that of monsoonal one (18.00%). It helps us to explain that variation in the occurrence of annual rainfall within the Basin is smaller than that of monsoonal rainfall. Since the degree of difference between the highest and the lowest monsoonal variabilities of the Basin is higher than that of annual one, the variability in monsoonal rainfall has greater influence in shaping the nature & pattern of rainfall in the Basin under study.

c. <u>Rainfall Persistence</u>

Due to meteorological and climatic causes, it has been found that both wet as well as dry years tend to occur in groups. This tendency in grouping, having the carriover effect of the immediate antecedent rainfall conditions is the indication of the presence of persistence in rainfall phenomena. Thus, the presence of persistence, in annual rainfall for a period of 'N' years, indicates that, the successive members (i.e., yearly rainfall data) in the time series are linked among themselves or in other words are dependently distributed in time i.e., wet years tend to follow wet years & dry years tend to follow dry years & thereby non-random in nature (Dawdy & Matalas 1964). A random time series is that where non-persistence exists in yearly rainfall. Thus, in a random time series each successive events furnish new informations in comparison to the non-random time series where successive events are linked up with each other.

The persistence i.e., non-randomness in the annual rainfall of the Rakti Basin has been determined by means of first order serial correlation (Dawdy & Matalas, 1964). The first order serial correlation is that which explains whether the serial dependance of the no. of events in successive annual rainfall is present or not in a time series of certain number of years.

The formula (Dawdy & Matalas, 1964.) used for computation of the Rainfall persistence for the Basin under study is as follows :

$$r_1 = \frac{\frac{1}{N-1}\sum_{i=1}^{N-1} Xi\,Xi+1 - \frac{1}{(N-1)^2}\left(\sum_{i=1}^{N-1} Xi\right)\left(\sum_{i=1}^{N-1} Xi+1\right)}{\left[\frac{1}{N-1}\sum_{i=1}^{N-1} Xi^2 - \frac{1}{(N-1)^2}\left(\sum_{i=1}^{N-1} Xi\right)^2\right]^{\frac{1}{2}} \left[\frac{1}{N-1}\sum_{i=1}^{N-1} X^2i+1 - \frac{1}{(N-1)^2}\left(\sum_{i=1}^{N-1} Xi+1\right)^2\right]^{\frac{1}{2}}}$$

Where r_1 = First order serial correlation coefficient.
N = Length of time series of different stations.
Xi = Mean rainfall of different years.

If a time series is random or non-persistent $r_1 = 0$. However for a sample of finite size, computed values of r_1 may differ from zero because of sampling errors.

Therefore, a test of significance of r_1 for the nine rain-gauge stations has been carried out by using the following formula (Dawdy & Matalas, 1964).

$$CL(r_1) = -\frac{1}{N-1} \pm t_\alpha \frac{\sqrt{N-2}}{N-1}$$

Where $CL(r_1)$ = Confidence limits for a computed value of r_1.
t_α = The standardized normal variate corresponding to the probability level $1-\alpha$. At 95 per cent level, $t_\alpha = 1.96$.

If the computed values of r_1 lie within the confidence limits, the r_1 is considered to be insignificantly different from zero at the probability level $1-\alpha$. If a r_1 is greater than confidence limits at probability level $1-\alpha$, r_1 is significant. A significant r_1 is an indication of nonrandomness or persistence in the successive values of yearly rainfall. In case of positive r_1 the high values of annual rainfall are followed by high values & low values by low values. The r_1 of nine rainfall stations of the Basin under study along with their confidence limits have been given in Table IV.5 below :

Table IV.5

First order serial correlation (r_1) with confidence limits $CL(r_1)$

Name of the Rain-gauge stations	First order serial correlation coeffs. (r_1)	$CL(r_1)$ confidence limits at 95% level of significance	Remarks
Putinbari T.E.	-0.32	0.6 to -0.45	Insignificant
Fulbari T.E.	0.25	0.33 to -0.41	"
Simulbari T.E.	0.24	0.39 to -0.32	"
Marionbari T.E.	1.90	0.50 to -0.39	Significant
Longview T.E.	0.61	0.34 to -0.42	"
Gayabari T.E.	0.26	0.39 to -0.32	Insignificant
Gourisankar (Castleton) T.E.	0.11	0.50 to -0.39	"
IOW Kurseong	-0.04	0.36 to -0.46	"
Singell T.E.	0.36	0.40 to -0.33	"

It is observed from the Table IV.5 that the r_1 for the annual rainfall of Marionbari T.E. and Longview T.E. are significantly different from zero at 95% level. These two tea estates being situated adjacent to each other on the transitional zone in between the hills & the plains show that the yearly rainfall received by them are not random. Inversely the rainfall of successive years of these two areas are linked among themselves in significant persistent manner. Moreover, in both the cases the r_1 values are positive, which is an indication that either the high values of annual rainfall have been followed by high values or low values by low ones. It should be noted further that the amplitude of r_1 for Marionbari T.E. is greater than that of Longview T.E. This is also an indication that the serial dependence among the yearly rainfall of Marionbari is stronger than that of the Longview T.E. (Elhance 1984). In case of Singell T.E., although the value of r_1 is seen insignificant at 95% level, still the magnitude of insignificance of r_1 is less, since the value of r_1 (+ 0.36) is very close to the upper value of the confidence limit (+ 0.4) calculated for it. Therefore it can easily be stated that to a certain extent non-randomness or a tendency of persistence is also present in annual rainfall of this area. For rest of the stations in the Basin under study the r_1 of the annual rainfall are insignificantly different from zero at 95% level which indicates that the rainfall of successive years for all these stations are independently distributed. Thus the randomness in the annual rainfall of all these stations does not help us to predict their nature rightly since each event (each yearly rainfall individually) in the series of annual rainfall may give us each new information & so, the rainfall patterns seem to be haphazard.

d. Trend of Rainfall

Trend is explained as an unidirectional diminishing or increasing change in the average values of variables at a time series. So trend is time-homogeneous.

There are several statistical methods to analyse the trend. For analysing the annual rainfall trend of different rain-gauge stations of the Rakti Basin under study the commonly used method of 'Moving average' has been taken into consideration. A method of moving average consists of overlaping means of 'm' successive weighted values. A simple moving average refers to the case where each of the weights equals 1. For the Rakti Basin the simple moving average having a convenient odd value of 'm' equal to 5 has been used for analysing the trend of the annual rainfall of different rainfall stations of the study area. Since the oscillatory component is the part of the trend of moving average the variance of the induced oscillation **has** also been calculated for each rain-gauge station of the Basin. The method used for the calculation of the variance of induced oscillation is 1/m times the variance of random element (Dawdy & Matalas 1964). The values of variance of induced oscillation of the nine rain-gauge stations of the Basin under study are given in the Table IV.6 below.

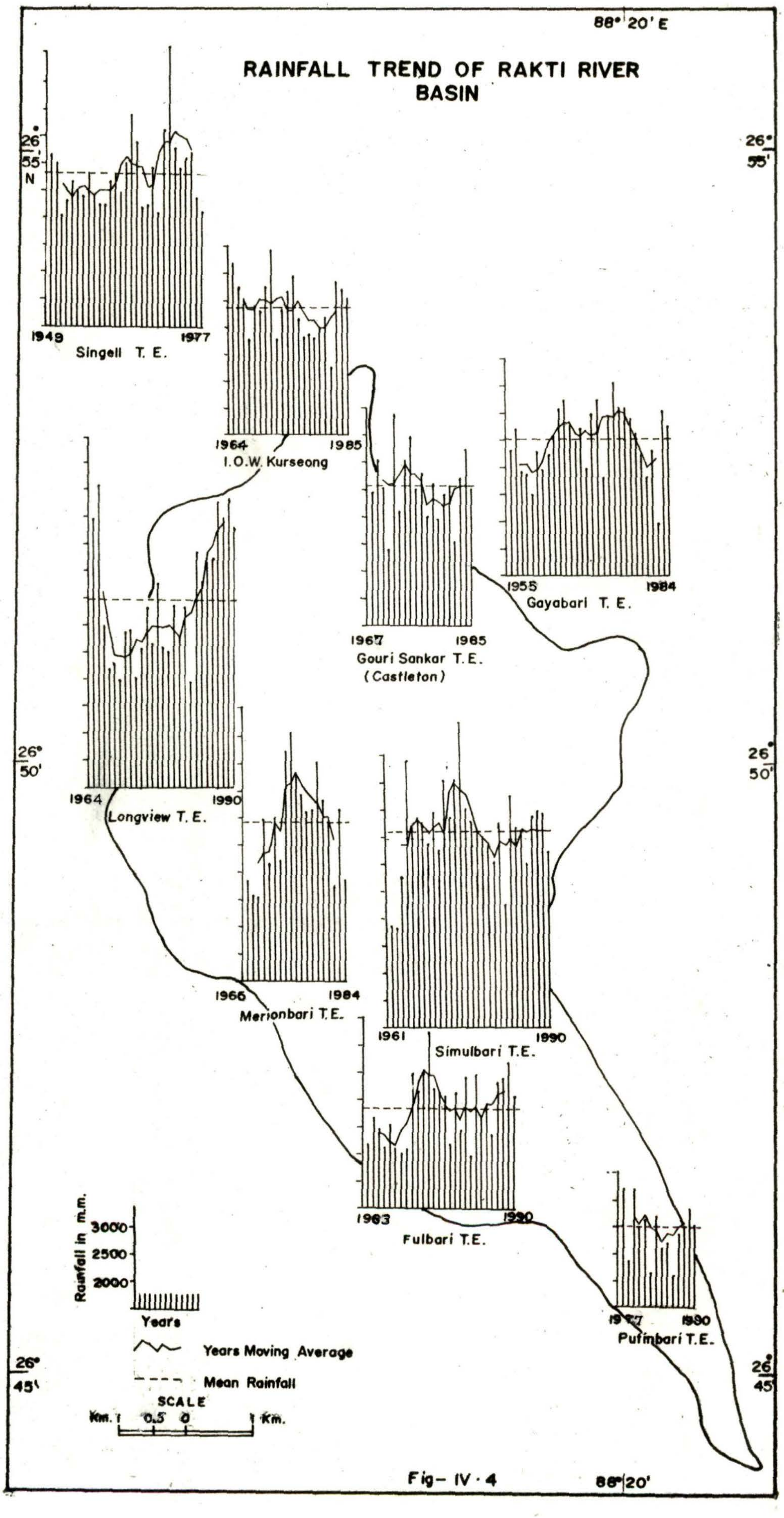
Table IV.6

Rain-gauge stations with the values of variance of induced oscillation

Name of the Rain-gauge Stations	Variance of induced oscillation in m.m.
Putinbari Tea Estate	49541.1
Fulbari Tea Estate	74273.7
Simulbari Tea Estate	139745.8
Marionbari Tea Estate	154247.0
Longview Tea Estate	258553.8
Gayabari Tea Estate	87860.8
Gourisankar Tea Estate (Castleton)	77700.6
I.O.W Kurseong	53934.5
Singell Tea Estate	88312.05

The curves of moving averages fitted on the diagrams of annual rainfall fluctuations of different rain-gauge stations of the Basin under study in the Fig.IV.4 show that there are apparent trends of annual rainfall in all the stations of the Basin. But the most distinct & long trends of rainfall are seen in case of Longview as well as Marionbari Tea Estate and Singell Tea Estate also (which has fallen just out side the Basin area on the north west) with slight distortion. The variance of induced oscillations for Longview and Marionbari Tea Estates are also highest being 258553.8 and 154247 m.m. respectively among the rest of the stations. In case of Singell T.E. the expected variance of induce oscillation about the trend is higher than rest of the stations except Simulbari Tea Estate where the variance of induced oscillation is seen higher but the trend is less prominent. Since the trend or long term movement and oscillation, both are the properties of nonrandomness of a time series, the presence of distinct trends and the highest values of the variance of induced oscillations in both cases of Longview & Marionbari T.Es prove that the annual rainfall of these two stations are nonrandom. Thus the presence of persistence in annual rainfall for Longview & Marionbari T.E. once already proved by the method of serial correlation is firmly corroborated by the trend analysis again. The same is the case for Singell T.E. also.

Apart from the presence of distinct trend an increasing tendency of rainfall, for the stations Longview, Gayabari, Singell and Fulbari Tea Estates, is also visible when we compare the no. of dry years (registering the values below mean annual rainfall values) between the beginning and end of the time series of the above stations. It is found from the diagrams of annual rainfall fluctuations in the Fig.IV.4 that for all the stations mentioned above the no. of dry years in a five & ten years period, are more in the beginning than that of the ending phase of rainfall series. In Longview T.E. the no. of dry years



88° 20' E
RAINFALL TREND OF RAKTI RIVER BASIN
26° 55' N
26° 55'
1949
1977
Singell T. E.
1964
1985
I.O.W. Kurseong
1955
1984
Gayabari T. E.
1967
1985
Gouri Sankar T. E.
(Castleton)
1964
1990
Longview T. E.
26° 50'
26° 50'
1966
1984
Merionbari T.E.
1961
1990
Simulbari T.E.
1963
1990
Fulbari T.E.
1977
1990
Putinbari T.E.
Rainfall in m.m.
3000
2500
2000
Years
Years Moving Average
Mean Rainfall
SCALE
Km. 1
0.5
0
1 Km.
26° 45'
26° 45'
88° 20'

Fig- IV · 4

for the first five and ten years are 3 and 8 respectively in comparison to the dry years for the last five as well as ten years which are 0 and 2 respectively. In Gayabari T.E. for the first five and ten years 4 and 7 respectively where as for the last five and ten years the dry periods are 3 and only 4 respectively. The case is same for the Singell Tea Estate for first five and ten years i.e., 3 and 8 respectively and for last five and ten years they are 2 and only 3 respectively. Fulbari patan Tea Estate which is situated in the plain area of the Basin under study shows a remarkable dry period of consecutive 8 years in the beginning. Where the first five years are totally dry, only 1 year is dry for the last five years of this rainfall series and when the consecutive 8 years show dryness in ten years period of the annual rainfall in the beginning, only 4 years are below the mean annual rainfall value at the last ten years period of the rainfall series. For the rest of the stations the increasing as well as the decreasing tendency of yearly rainfalls are not so prominent and thereby their natures seem to be fluctuating.

To sum up the findings on annual rainfall trends and the increasing attitude of the rainfall stations of the Basin under study the following conclusions may be drawn :

1. Among the rainfall stations having distinct trend in annual rainfall, the Longview Tea Estate has shown a steady rise in the five years moving averages of annual rainfall (as seen in Fig.IV.4). In case of Singell Tea Estate the trend in five years moving averages of annual rainfall is overall rising in nature despite having short term fluctuations. Marionbari Tea Estate shows both the increasing and decreasing trend.

2. Among the five rainfall stations falling in the hill portion of the Basin under study three of them i.e., Longview, Gayabari & Singell Tea Estates, show an increasing tendency in annual rainfall. This is an indication that the hill region is

getting more rainy years than that of previous time.

3. Except Fulbari Patan Tea Estate area, in the whole plain portion of the Basin the tendency of annual rainfall is not increasing in nature. Therefore the plain area of the Basin under study is receiving comparatively less rainy years than that of hill.

SUMMARY OF CONCLUSIONS

From the above analysis of rainfall depth, variability, persistence and trend some distinct interrelationships among the above parameters are found which ultimately lead to draw some important conclusions as follows :-

1. It is found from the spatial distribution of annual variability & rainfall depth that the low variability i.e., below 15% has occupied the areas of lower degree of rainfall depth zones like 3931.30 & 4154.40 mm. & the higher degree of variability of rainfall pattern, in a greatest areal extent, has similarly been conformed with the higher rainfall depth zones in the Basin under study. It focuses that the areas of low rainfall in the Basin depicts more consistency in the occurance of yearly rain than the high rainfall areas where the amount of variation in the yearly rainfall of successive rainy years is higher & thus to a certain extent explains its erratic nature. Since a great portion of the area of the Basin receives high amount of rainfall, this erratic nature of rain is thus prevalent in a wide areal extent of the Basin under study.

2. The range interval between the highest & the lowest percentages in monsoonal rainfall variability being higher than that of mean annual variability explains that the degree of consistency in the occurrence of monsoonal rainfall is more

changing in character from one place to another in comparison to annual rainfall. Since 80% of rainfall of an area in our country comes from monsoon period as explained by Biswas & Maske (1981), it can be said without doubt that in general the distribution pattern in the occurrence of rainfall of the Basin area is inhomogeneous in character. Thus lack of the systematic occurrence of rain & the evenness in rainfall pattern from place to place is prominent in the rainfall characteristics of the Basin under study.

3. Most of the area of the hill portion of the Basin under study which has shown the increasing tendency in annual rainfall, has also depicted higher annual rainfall depths in comparison to the plain area of the Basin. In the plain there has been a mixture of varied rainfall depths in association with an irregular tendency in annual rainfall.

4. The presence of persistence and distinct trend in the annual rainfall of Marionbari, Longview Tea Estates in the transition of hills & plains on the west of the Basin area and Singell Tea Estate on the north western corner of the Basin, indicate that the annual rainfall of these areas covering a narrow zone of the Basin are understandable and systematic in nature. The rest of the rainfall stations covering largest area of the Basin under study show randomness and thereby lack of persistent manner as well as less distinct trends in the annual rainfall series which are the indication that they are haphazard and unpredictable in nature. Thus such unpredictable nature of rainfall covering most of the area of the Basin ultimately explains that the Basin, is suffering from highly fluctuating annual rainfall which as such proves its erratic nature once again.

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