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Quantitative precipitation forecast for the Brahmaputra and the Barak basins by synoptic analogue technique

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सार – इस शोध पत्र में भारत के पूर्वोत्तर क्षेत्र के ब्रह्मपुत्र बेसिन और बराक बेसिन के लिए सिनॉप्टिक एनालॉग तकनीक (SAT) द्वारा मात्रात्मक वर्षण पूर्वानुमान (QPF) जारी करने के लिए मॉडल तैयार किया गया है जिसमें ब्रह्मपुत्र नदी के पंद्रह उप-जलग्रहण क्षेत्र और बराक नदी का एक जलग्रहण क्षेत्र शामिल है। इस मॉडल के विकास के लिए बाढ़ के मौसम (15 मई से 15 अक्तूबर) के दस वर्ष के आँकड़ों (2001-2010) का उपयोग किया गया है। इनसे प्राप्त हुए परिणामों को प्रत्येक उप-जलग्रहण क्षेत्र के 2011 में आई बाढ़ के समय तदनुरूप सिनॉप्टिक परिस्थितियों के लिए वास्तविक औसत आकाशीय वर्षण (AAP) के साथ सत्यापित किया गया। 2 X 2 आकस्मिक सारणी के आधार पर विभिन्न स्किल स्कोरों की गणना की गई तथा यह पाया गया कि विकसित मॉडल समुचित उच्च सटीकता के साथ QPF दे सकता है और ये अच्छा पूर्वानुमान देने में माहिर है।

ABSTRACT. The paper formulates a model for issuing quantitative precipitation forecast (QPF) by Synoptic Analogue Technique (SAT) for the Brahmaputra basin and the Barak basin of North East Region of India (NER) comprising fifteen sub-catchments of the river Brahmaputra and a single catchment of the river Barak. Ten years data (2001-2010) during the flood season (15 May to 15 October) have been used in developing the model. The results so obtained were verified with the realised Average Areal Precipitation (AAP) for the corresponding synoptic situations during the flood season 2011 for each sub-catchment. Based on 2 × 2 contingency table, different skill scores were calculated and found that the model so developed can produce QPF with reasonable higher accuracy and has good forecast skill.

Key words – QPF, SAT, AAP, NER, Brahmaputra basin, Barak basin, Sub-catchment, Contingency table.

1. Introduction

The monsoon in NER of India (NER) is characterised by low clouds, high humidity and heavy to very heavy rainfall occasionally leading to flood. In view of flood proneness, quantitative precipitation forecast (QPF) over the river catchment areas is an important input to flood warnings. The issuance of accurate QPF over a particular river catchment is remaining itself a great challenge to the forecasters. The problem further deepens over NER owing to its geographic location and complex physiographic settings and also due to the complex orientation of the river catchments. The poor observatory network and wide data gap especially over the elevated hilly areas contribute to the problem as well. Due to wide data gap areas over ocean and remote hilly locations, as well as the poor Meteorological data network, synoptic base QPF method had been found more suitable for Indian region for flood forecasting purposes. However, a relatively higher uncertainty remains due to the subjectivity involved in locating a synoptic system and its intensity. Like, other FMOs, FMO Guwahati has also been issuing QPF in different ranges (Table 1) based on prevailing synoptic weather systems for the 16 river sub-catchments of NER.

Several authors studied the rainfall relation with respect to the prevailing synoptic situations in terms of occurrence, distribution and intensity in different river catchment areas of India. Rao *et al.* (1970) examined the Synoptic Analogue technique (SAT) for issuing QPF over Ganga Barrage catchment. There are several other researchers, like, Lal *et al.* (1983); Abbi *et al*. (1979); Rao *et al*. (1997) studied QPF for Gomti Catchment, Bhagirathi Catchment and Teesta basin based on Synoptic Analogue Method. Recently, Raha *et al*. (2009) and Ali *et al.* (2011) have used synoptic analogue technique for modeling QPF over Teesta basin and lower Yamuna

catchment and concluded that the technique has a reasonably good skill over the respective catchment area. Singh *et al.* (2010a, 2010b) concluded that synoptic analogue method could perform with confidence in issuing semi-QPF for Kamala Balan Catchment and Kosi/Mahananda catchments. Though there are many literatures available for issuing QPF by SAT for different river catchment areas of the country, but there is none for the river catchments of NER. Therefore a necessity is felt to develop a model following SAT for the river catchments of NER and therefore this study aims to develop a composite and comprehensive synoptic analogue model to predict the occurrence and quantity of precipitation during the next 24 hours over the sixteen sub-catchments of river Brahmaputa and the river Barak, due to different synoptic settings based on observations upto 0300 UTC of the day.

TABLE 1

QPF ranges are in use at FMO Guwahati

S. No.	QPF Category	Rainfall (mm)
1.	No Rain	$0.0 \leq R/F < 0.5$
2.	1-10	$0.5 \leq R/F < 10.5$
3.	11-20	$10.5 \leq R/F < 20.5$
4.	21-35	$20.5 \leq R/F < 35.5$
5.	36-50	$35.5 \leq R/F < 50.5$
6.	51-65	$50.5 \leq R/F < 65.5$
7.	66-80	$65.5 \leq R/F < 80.5$
8.	81-100	$80.5 \leq R/F < 100.5$
9.	Above 100	> 100.5

2. Data and methodology

The parameters considered for the modeling QPF are the daily synoptic situations and the corresponding realised Average Areal Precipitations (AAPs) on the next day for the sixteen sub-catchments of NER from 15th May to 15th October for a period of ten years (2001-2010). The AAPs are calculated by isohyetal analysis of point rainfall data using grid method for the period 2002-2010 and for 2001 it is calculated by using arithmetic mean of the available point rainfall data.

The synoptic situations are collected from the daily weather reports published by Regional Meteorological Centre Guwahati. If in a particular day, multiple systems are reported, then the systems having most significance influences on the rainfall distribution over the region and also on the intensity and proximity of the system to the region have been considered. The days with no significant synoptic situations were not considered in the present study. For coding a particular synoptic situation the following system codes and area codes have been used.

(*i*) *SYSTEM CODE* (*S*)

LO : Low / Well Marked Low

DP : Depression / Deep Depression

CS : Cyclonic Storm

CY : Upper air CYCIR

TR : TROUGH (Trough of Low / Monsoon Trough / East-West Trough) passing through or up to NER

TW: Trough in Monsoon Westerlies / North South Trough between 85° E - 89° E north of 20° N.

(*ii*) *AREA CODE* (*A*)

E-UP : East UP

BHR : Bihar

E-MP : East MP & Adj. Area

CTS : Chhattisgarh & N'hood

ORS : Orissa

JRK : Jharkhand & N'hood

SHWB : Sub Himalayan West Bengal & Sikkim

GWB : Gangetic West Bengal & N'hood

BD : Bangladesh & N'hood

W-ASS : West Assam & Meghalaya & N'hood

C-ASS : Central Assam & N'hood

NE-ASS: NE Assam & N'hood

NW-BAY: North West Bay

NE-BAY: North East Bay

WC-BAY: West Central Bay

EC-BAY: East Central Bay

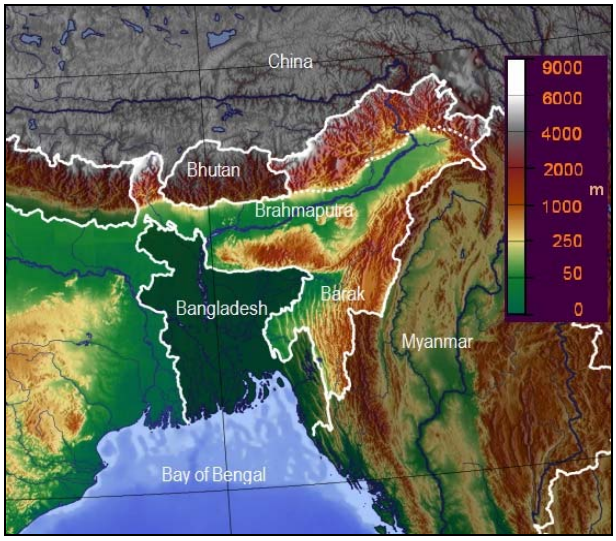


Fig. 1. The physiographical map of North-East Region of India

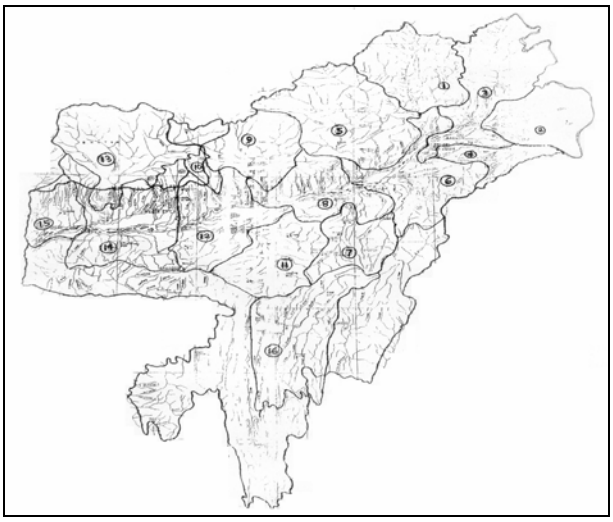
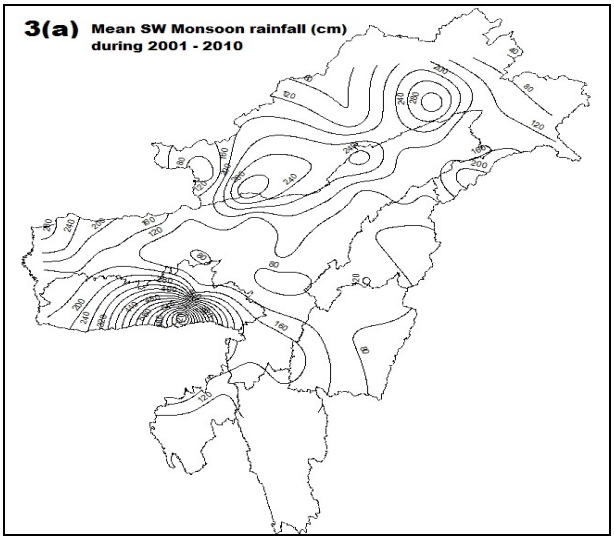
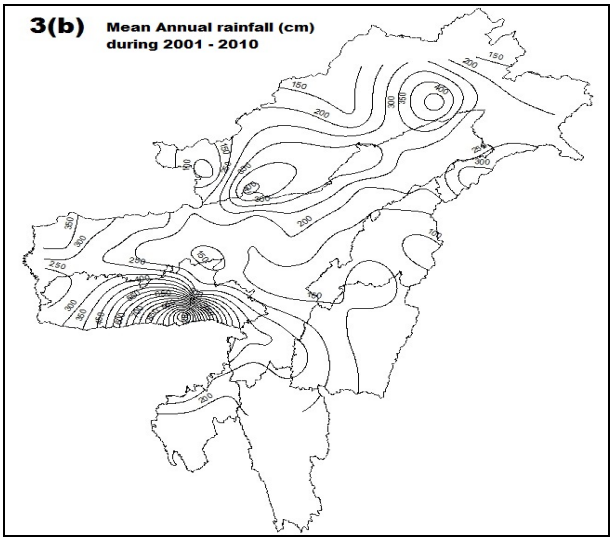


Fig. 2. Sixteen Catchments of the River Brahmaputra and the River Barak





Figs. 3(a&b). (a) Mean SW monsoon rainfall (cm) and (b) Mean Annual rainfall (cm) over the study area during 2001-2010

The contributions of the above systems located over the above areas are considered in the present study as the influence from the systems outside these areas is negligible. The synoptic situation code is considered as a combination of system code followed by area code as S : A, *e.g*.,

CODE: CS: WC-BAY; DECODE: A cyclonic storm over WC Bay

CODE: CY: BD; DECODE: An Upper air CYCIR lies over Bangladesh

The AAP range where the probability of occurrence attains or exceeds 50% is considered as the forecast range. The AAPs during the flood season of 2011 have been used for validation of the forecast for each catchment. The verification is made in terms of its occurrence/non-occurrence (yes/no) using 2 × 2 contingency table and computing various skill scores like, probability of detection (POD), false alarm rate (FAR), missing rate (MR), correct non-occurrence (C-NON), critical success index (CSI), bias for occurrence (BIAS), percentage correct (PC) and true skill scores (HSS) at different F/C ranges in different catchment areas. The final skill scores for a catchment area is the average of a particular score at different forecast ranges over the same catchment area.

TABLE 2

Orographic distribution of Catchment area

Cat. No.	Name of rivers & drainages	Total area (sq. km)	Area (sq. km) under		Area in % under	
			Mountainous	Plains	Mountainous	Plains
1.	Dehang at Passighat	14020	14020	-	100	0
2.	Lohit at Dholla	13352	12684	668	95	5
3.	Brahamaputra at Dibrugarh	16022	12684	3338	79	21
4.	Buridhing at Khowang	6008	3338	2670	56	44
5.	Subansiri at Badatighat	22698	18693	4005	82	18
6.	Brahmaputra at Neamatighat	12017	5341	6676	44	56
7.	Dhansiri (south) at Golaghat	8679	6676	2003	77	23
8.	Brahmaputra at Tezpur	12017	2003	10014	17	83
9.	Dhansiri (North) at Rly. Bridge X-ing	10682	10014	668	94	6
10.	Jiabharali at N.T. Rd. X-ing	2003	1669	334	83	17
11.	Kapili at Kampur	12017	8679	3338	72	28
12.	Brahmaputra at Guwahati	14687	4673	10014	32	68
13.	Manas/ Beki at Beki Rd. Bridge X-ing	18693	17691	1002	95	5
14.	Brahmaputra at Goalpara	18693	8679	10014	46	54
15.	Brahmaputra at Dhubri	6008	668	5340	11	89
16.	Barak at Silchar	22698	16022	6676	71	29

3. Topography of NER

The entire region of North-East can broadly be divided into two characteristic zones-mountainous and plain. The topographical features of the region are shown in Fig. 1. Although distinguished in the altitude differences, both the mountain and plain areas are closely interrelated in terms of precipitation regime. The latitudinal and longitudinal boundary of the region is roughly from 22° N to 30° N and 90° E to 97° E. Within this boundary the entire Bangladesh and a part of Myanmar also lies towards south and south east of the region respectively. The region has two valleys, *viz*., the Brahmaputra Valley and the Barak valley. The Brahmaputra valley is surrounded by the great Himalayan range in the north and Garo-Khasi-Jayantia hills and North Cachar Hills in the south and the Naga-Patkai hills in the Southeast. The average height of the Garo, Khasi & Jaintia hills is around 1 to1.5 km and Naga-Patkai hills have an average height of 3 kms whereas the height of the mountains in Arunachal Pradesh ranges between 3 to 5 km. On the other hand the Barak valley lies on the southern slope of North Cachar Hills and is surrounded by Borail ranges. The Barak valley is wide open to the southwesterly moist winds coming from Bay of Bengal. The total area of NER is 2,10,294 sq. kms of which only 66,760 sq. kms is plain area and rest 1,43,534 sq. kms (*i.e*., 68%) is mountainous area. This unique geographical setting of the region is considered as the contributing factor in making the region one of the wettest areas of the world.

4. Characteristics of the Brahmaputra and Barak basins

The Brahmaputra and the Barak are the two major rivers of NER. The mighty river Brahmaputra originates from the glacial of Himalayas at an elevation of about 5300 m. From the Indo-China border to the Indo-Bangladesh border, it flows 918 km through India of which 278 km through the mountainous state of Arunachal Pradesh flowing mainly in the southern direction. The next 640 km length is through the Brahmaputra valley where the river flows mainly in west direction with some southern trend. The catchment area of the entire river is 580,000 sq. km, out of which about 190,000 sq. km lies in India. The river is joined by as many as 30 tributaries from the north and 20 tributaries from the south. The catchments of the north bank tributaries lie in the Himalayan range and both in size and

TABLE 3

Rainfall statistics for some stations of NER during 2001-2010

Stations	Mean annual rainfall in cm	Mean seasonal (JJAS) rainfall in cm	Seasonal (JJAS) Mean frequency of		Total No. of very heavy rain (JJAS)	Frequency of Ex. heavy rain (JJAS)	24 hours max RF in mm (JJAS)	Date of max rainfall
			Rainy days (≥ 2.5 mm in 24 hrs)	Heavy rainfall days (≥ 64.5 mm in 24 hrs)				
Dhubri	230	142	53	5.2	5	1	312.0	09 Jun 2007
Gossaigaon	356	260	69	11.8	38	3	293.2	30 Aug 2008
Kokrajhar	349	239	68	10.8	25	3	285.4	26 Aug 2002
Goalpara	257	156	58	4.7	5	1	420.6	14 Jun 2002
Aie N. H. Xing	318	214	61	9.4	20	2	286.4	13 Jun 2003
Beki Rd. Bridge	278	179	60	6.4	10	0	229.4	10 Sep 2010
Mellabazar	284	186	60	7.9	15	0	205.4	01 Jun 2006
Tamulpur	250	145	53	5.2	3	0	240.2	26 Jul 2008
Goibargaon	220	137	53	4.1	10	0	186.4	23 Jul 2002
Guwahati	173	100	52	1.9	3	0	135.7	19 Aug 2005
Puthimari	174	97	49	1.7	2	0	140.4	17 Jun 2007
Dharamtul	167	109	57	1.8	2	0	158.0	22 Jun 2001
Tangla	195	116	49	2.6	4	0	154.0	09 Aug 2005
Tezpur	169	98	54	1.4	0	0	109.7	04 Aug 2002
Kampur	149	97	47	1.3	0	0	124.2	01 Jul 2001
Chaparmukh	160	102	49	2.1	4	0	176.2	14 Jul 2008
Lumding	119	70	41	1.4	0	0	121.6	25 Aug 2007
Bakulia	192	123	57	2.4	1	0	147.5	06 Sep 2003
Kherunighat	120	72	44	1.1	1	0	136.0	26 Jul 2006
Bokajan	131	88	45	1.7	1	0	131.0	28 Jun 2008
Golaghat	165	101	56	1.6	0	0	89.4	05 Sep 2002
Neamatighat	170	104	55	1.6	1	0	141.5	08 Jun 2009
Jorhat	176	107	58	2.0	0	0	124.0	17 Jun 2008
Sibsagar	198	125	57	2.9	3	0	161.6	03 Aug 2008
Bihubar	200	143	65	3.4	2	0	150.2	05 Aug 2002
Khowang	234	146	65	3.6	3	0	182.7	12 Aug 2009
Mohanbari	251	157	69	3.8	4	0	138.8	04 Jul 2006
N.Lakhimpur	313	216	75	6.6	5	0	207.8	16 Jun 2010
Chouldhoaghat	346	255	76	10.9	9	1	269.4	13 Aug 2009
Dhollabazar	238	149	60	3.9	4	0	175.0	06 Aug 2006
Dillighat	229	155	66	4.0	4	0	153.2	27 Aug 2007
Jiagaon	224	135	51	4.5	5	0	200.6	12 Jul 2005
Naharkatia	222	150	62	4.0	3	0	152.4	11 Jul 2006
Margherita	240	151	67	3.4	1	0	137.1	26 Jun 2002
Silchar	305	185	79	5.1	4	0	165.2	12 Jun 2006
Amraghat	295	190	80	5.2	7	0	196.8	17 Jul 2001
Dholai	279	177	78	4.5	5	0	167.3	12 Jun 2006
Gharmura	223	142	63	3.5	6	0	229.5	13 Jun 2006
Karimganj	343	212	76	7.0	14	1	272.2	12 Jun 2006
Itanagar	326	216	75	5.8	3	1	261.4	14 Jun 2008
Passighat	418	297	68	14.4	41	6	450.3	18 Jul 2004
Miao	248	152	65	4.0	0	0	118.5	10 Jul 2004
Namsai	234	142	61	3.1	4	0	170.1	10 Jul 2004
Bhalukpong	410	308	77	14.7	36	3	320.0	15 Sep 2001
Daporizo	160	92	58	1.3	3	0	132.6	29 Aug 2006
Dirang	89	61	52	0.1	0	0	84.0	04 Jul 2008
Changlang	180	108	68	0.5	1	0	140.0	07 Sep 2005
Hawai	204	84	55	0.9	0	0	111.2	17 Jul 2004
Shillong	219	147	69	3.8	9	0	223.4	29 Jul 2001
Barapani	218	134	68	2.3	3	0	132.6	08 Sep 2007
Cherrapunjii	1116	805	96	37.0	134	79	793.2	19 Jul 2004
Imphal	138	79	53	1.1	1	0	137.1	26 Sep 2003
Kohima	173	121	76	1.1	1	0	134.2	04 Sep 2003
Phek	147	93	62	0.4	0	0	74.8	23 Jun 2007
Mon	178	111	70	1.0	0	0	84.0	08 Aug 2006
Kiphira	86	58	52	0.1	0	0	100.4	18 Jul 2006
Aizawl	206	133	72	2.0	1	0	127.0	08 Jun 2003
Lengpui	230	147	67	3.2	2	0	140.6	20 Sep 2005
Agartala A/P	213	129	58	3.6	7	0	230.2	24 Jun 2004
Kailasahar	257	153	71	3.4	5	0	153.5	20 Jul 2004

TABLE 4

Summary of AAPs in sub-catchment No. 1

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	0.0	-	1	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
2.	CS:NW-BAY	2.2	3.1	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	6.4	8.9	4	1(25)	2(50)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	3.2	6.7	15	8(53)	6(40)	0(0)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
5.	DP:WC-BAY	1.4	1.6	15	7(47)	8(53)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.0	0.0	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	**10.9**	**10.8**	5	1(20)	2(40)	1(20)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
8.	DP:BD	**33.1**	**15.4**	2	0(0)	0(0)	0(0)	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	21-35
9.	DP:JRK	6.0	9.6	9	0(0)	8(89)	0(0)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	1.4	2.3	14	8(57)	6(43)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
11.	DP:CTS	3.6	4.3	8	1(13)	6(75)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	1.4	1.9	5	2(40)	3(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	1.5	2.9	12	8(67)	4(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
14.	LO:NW-BAY	3.0	7.0	115	70(61)	36(31)	4(3)	4(3)	1(1)	0(0)	0(0)	0(0)	0(0)	No rain
15.	LO:EC-BAY	0.1	0.2	9	8(89)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	1.9	3.5	40	25(63)	13(33)	2(5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	8.5	18.7	8	4(50)	3(38)	0(0)	0(0)	0(0)	1(13)	0(0)	0(0)	0(0)	No rain
18.	LO:BHR	5.3	6.5	12	5(42)	4(33)	3(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	2.5	4.1	29	18(62)	9(31)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
20.	LO:ORS	3.9	6.9	28	14(50)	11(39)	2(7)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
21.	LO:CTS	3.5	7.7	33	17(52)	12(36)	2(6)	2(6)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
22.	LO:E-MP	4.0	6.1	32	13(41)	14(44)	4(13)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	1.7	2.7	3	2(67)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
24.	LO:GWB	3.6	10.3	23	12(52)	9(39)	1(4)	0(0)	1(4)	0(0)	0(0)	0(0)	0(0)	No rain
25.	LO:BD	5.2	7.0	10	3(30)	4(40)	3(30)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	0.1	0.1	7	7(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	3.5	5.8	67	28(42)	34(51)	3(4)	2(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	2.3	4.0	26	16(62)	8(31)	2(8)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
29.	CY:E-UP	2.3	5.5	29	19(66)	8(28)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
30.	CY:BHR	7.7	15.4	50	25(50)	16(32)	3(6)	2(4)	2(4)	1(2)	1(2)	0(0)	0(0)	No rain
31.	CY:JRK	2.4	4.6	30	15(50)	13(43)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
32.	CY:ORS	3.3	4.9	20	7(35)	11(55)	2(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	**12.6**	**15.2**	11	4(36)	2(18)	2(18)	1(9)	2(18)	0(0)	0(0)	0(0)	0(0)	11-20
34.	CY:E-MP	2.0	1.6	6	1(17)	5(83)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	7.6	13.2	35	11(31)	15(43)	6(17)	1(3)	1(3)	0(0)	1(3)	0(0)	0(0)	1-10
36.	CY:GWB	7.5	17.9	29	12(41)	12(41)	3(10)	0(0)	1(3)	0(0)	0(0)	1(3)	0(0)	1-10
37.	CY:BD	6.2	9.4	52	16(31)	27(52)	6(12)	2(4)	0(0)	1(2)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	2.8	4.5	22	8(36)	13(59)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	3.1	3.8	20	8(40)	11(55)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	5.7	11.8	44	18(41)	19(43)	5(11)	0(0)	1(2)	0(0)	1(2)	0(0)	0(0)	1-10
41.	TR	**26.3**	**48.4**	109	16(15)	43(39)	19(17)	14(13)	5(5)	1(1)	0(0)	2(2)	9(8)	1-10
42.	TW	9.5	14.8	43	8(19)	25(58)	6(14)	1(2)	1(2)	1(2)	1(2)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	**11.5**	**17.3**	11	2(18)	6(55)	1(9)	1(9)	0(0)	1(9)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	**45.0**	**42.6**	3	1(33)	0(0)	0(0)	0(0)	1(33)	0(0)	0(0)	1(33)	0(0)	36-50
45.	LO:E-UP +TR	**50.6**	**44.2**	11	0(0)	2(18)	1(9)	3(27)	0(0)	1(9)	1(9)	2(18)	1(9)	21-35
46.	LO:BHR +TR	**15.8**	**16.2**	6	2(33)	1(17)	1(17)	1(17)	1(17)	0(0)	0(0)	0(0)	0(0)	1-10
47.	LO:JRK +TR	**32.9**	**25.5**	13	0(0)	4(31)	1(8)	2(15)	4(31)	1(8)	0(0)	1(8)	0(0)	21-35
48.	LO:ORS +TR	**11.1**	**11.7**	9	1(11)	3(33)	4(44)	0(0)	1(11)	0(0)	0(0)	0(0)	0(0)	11-20
49.	LO:CTS +TR	5.5	6.7	8	3(38)	4(50)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	**10.8**	**13.8**	10	1(10)	6(60)	1(10)	1(10)	1(10)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	**14.5**	**17.9**	10	0(0)	5(50)	2(20)	2(20)	0(0)	1(10)	0(0)	0(0)	0(0)	1-10
52.	LO:BD +TR	**14.5**	**25.1**	4	1(25)	2(50)	0(0)	0(0)	0(0)	1(25)	0(0)	0(0)	0(0)	1-10
53.	CY:NW-BAY+TR	9.3	9.7	16	2(13)	11(69)	1(6)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**16.5**	**18.8**	23	2(9)	9(39)	6(26)	2(9)	2(9)	1(4)	1(4)	0(0)	0(0)	11-20
55.	CY:BHR+TR	**28.7**	**32.9**	16	2(13)	4(25)	1(6)	4(25)	3(19)	1(6)	0(0)	0(0)	1(6)	21-35
56.	CY:JRK+TR	**35.8**	**42.9**	9	1(11)	2(22)	2(22)	1(11)	1(11)	0(0)	1(11)	0(0)	1(11)	11-20
57.	CY:ORS+TR	**21.6**	**32.6**	9	0(0)	4(44)	3(33)	1(11)	0(0)	0(0)	0(0)	0(0)	1(11)	11-20
58.	CY:CTS+TR	12.9	8.2	4	0(0)	1(25)	3(75)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
59.	CY:E-MP+TR	**16.8**	**20.4**	6	1(17)	2(33)	1(17)	1(17)	1(17)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	7.3	8.1	16	5(31)	7(44)	3(19)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	9.3	14.6	9	0(0)	7(78)	1(11)	0(0)	1(11)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	**11.6**	**10.6**	28	2(7)	11(39)	11(39)	3(11)	1(4)	0(0)	0(0)	0(0)	0(0)	11-20
63.	CY:W-ASS+TR	8.5	11.9	15	4(27)	8(53)	1(7)	1(7)	1(7)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	**15.6**	**23.3**	29	7(24)	12(41)	4(14)	1(3)	1(3)	2(7)	1(3)	1(3)	0(0)	1-10
65.	CY:BHR+TW	5.2	8.4	7	1(14)	5(71)	0(0)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	**14.4**	**26.7**	5	2(40)	2(40)	0(0)	0(0)	0(0)	1(20)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	**14.9**	**22.2**	10	0(0)	7(70)	1(10)	1(10)	0(0)	0(0)	1(10)	0(0)	0(0)	1-10
68.	TR+TW	**20.6**	**26.0**	45	6(13)	17(38)	6(13)	7(16)	3(7)	1(2)	3(7)	1(2)	1(2)	1-10
69.	CY:NE-SS+CY: NW-BAY	**20.5**	**51.5**	13	5(38)	5(38)	0(0)	2(15)	0(0)	0(0)	0(0)	0(0)	1(8)	1-10
	Total			1381	501(36)	572(41)	144(10)	74(5)	38(3)	16(1)	12(1)	9(1)	15(1)	

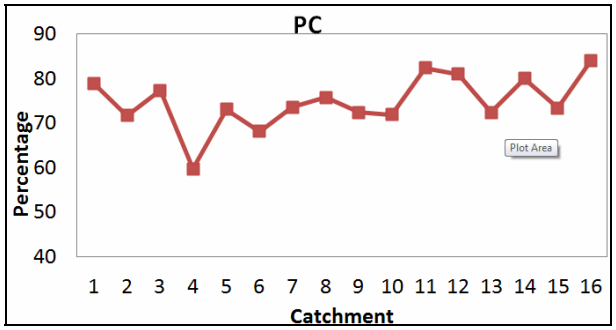


Fig. 4. PC of QPF based on SAT for the year 2011 in different sub-catchments

height they are bigger and receive higher rainfall than the catchments of the southern tributaries. The important north bank tributaries of the river Brahmaputra are subansiri, Dhansiri, Puthimari, Pagladiya, Manas and some of the south bank tributaries are Noa-Dehang, Burhi-Dehang, Dikhu, Kopili etc. On the other hand the Barak River originates from hill ranges of Borail. It flows upto Bangladesh and meets the river Brahmaputra. Before entering Bangladesh, the river bifurcates into two streams called the Surma and Kushiara. There are about 15 tributaries join to the river Barak. The principal tributaries are the Jiri, Dhaleshwari, Singla, Longai, Sonai and Katakhal.

Considering all the tributaries, sixteen sub-catchments have been identified. Sub-catchments numbers 1 to 15 comprises the Brahmaputra Basin, while sub-catchment number 16 constitutes Barak Basin. In most of these sub-catchments, the maximum areas are mountainous. The areas of the all these sub-catchments are shown in Fig. 2. The geographical settings of the sub-catchments are shown in Table 2. Both the river basins experience a wide variation of mean SW monsoon and annual rainfall [Figs. 3(a&b)] and are very much in accordance with the topographic orientation of the region. Occurrence of maximum rainfall over this region may broadly be divided into three distinct parts, *viz.*, (*i*) Barak valley and southern parts of Kashi-Jayantia Hills; (*ii*) plains of west Assam and along the foot hills of Bhutan and (*iii*) along the foot hills of Himalayas in Arunachal Pradesh. Rainfall is the minimum in the central parts of Assam and also in Nagaland and Manipur. The detailed statistics of rainfall at different stations of NER during the periods 2001-2010 is given in Table 3.

5. Results

All together sixty nine (69) synoptic systems have been identified which are affective in all the sixteen (16) sub-catchments of the Brahmaputra and the Barak river basins. Synoptic situations producing AAP in the ranges 36-50 mm or more were below 5% of the total cases in most of the sub-catchments; as such those situations are not discussed here. The sub-catchment wise results are furnished in the following sub-paras.

5.1. *Sub-Catchment No. 1*

The detailed summary is shown in Table 4. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 501 days (36%), (*ii*) 1-10 mm for 572 days (41%), (*iii*) 11-20 mm for 144 days (10%), (*iv*) remaining days were in the range of 21- 35 mm and more, (*v*) 21-35 mm for 74 days (5%) and (*vi*) remaining 90 days (7%) were in the range 36-50 mm and more.

(b) 11 most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Cyclonic Storm over NE Bay for a single occasion (100%), (*ii*) Depression over EC Bay for twice (100%), (*iii*) Low over NE Bay, NW Bay, EC Bay and WC Bay respectively for 8 (67%), 70 (61%), 8 (89%) and 25 (63%) occasions, (*iv*) Low over SHWB and Jharkhand respectively for 2 (67%) and 18 (62%) occasions, (*v*) CYCIR over NE Bay and WC Bay respectively for 7 (100%) and 16 (62%) occasions and (*vi*) CYCIR over East UP for 19 (66%) occasions.

(c) 9 most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were, (*i*) Depression over Jharkhand, Chhattisgarh and East MP respectively for 8 (89%), 6 (75%) and 3 (60%) occasions, (*ii*) CYCIR over East MP for 5 (83%) occasions, (*iii*) Trough passing through NER in association with Low over East MP for 6 (60%) occasions, (*iv*)Trough passing through NER in association with CYCIR over NW Bay and GWB for 11(69%) and 7(78%) occasions respectively and (*v*)Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over Bihar and NE Assam for 5 (71%) and 7 (70%) occasions respectively.

(*d*) There were two most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Trough passing through NER in association with Low over Orissa for 4 (44%) occasions and (*ii*) Trough passing through NER in association with CYCIR over, Chhatisgarh for 3(75%) occasions.

(e) There were three most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Depression over Bangladesh for single

TABLE 5

Same as Table 4 but for Sub-Catchment No. 2

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	0.1	-	1	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
2.	CS:NW-BAY	0.3	0.4	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	6.2	3.5	4	0(0)	3(75)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	3.3	6.1	15	8(53)	5(33)	1(7)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
5.	DP:WC-BAY	1.8	3.1	15	6(40)	8(53)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.0	0.0	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	11.1	7.8	5	1(20)	1(20)	3(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
8.	DP:BD	19.3	8.3	2	0(0)	0(0)	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
9.	DP:JRK	5.3	5.8	9	0(0)	8(89)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	2.9	4.6	14	7(50)	6(43)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
11.	DP:CTS	9.6	8.3	8	0(0)	5(63)	2(25)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	1.8	1.1	5	1(20)	4(80)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	2.7	5.4	12	7(58)	3(25)	2(17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
14.	LO:NW-BAY	4.0	7.1	115	54(47)	47(41)	8(7)	5(4)	1(1)	0(0)	0(0)	0(0)	0(0)	No rain
15.	LO:EC-BAY	0.3	1.0	9	8(89)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	3.4	6.7	40	23(58)	11(28)	5(13)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	4.4	4.3	8	1(13)	6(75)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	7.0	6.5	12	2(17)	6(50)	4(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	8.3	11.9	29	7(24)	16(55)	2(7)	3(10)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	6.9	7.4	28	5(18)	16(57)	5(18)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	6.6	9.5	33	10(30)	15(45)	5(15)	3(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	5.1	7.5	32	7(22)	20(63)	4(13)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	**14.8**	**12.8**	3	1(33)	0(0)	0(0)	2(67)	0(0)	0(0)	0(0)	0(0)	0(0)	21-35
24.	LO:GWB	2.8	4.0	23	10(43)	10(43)	3(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	6.9	10.5	10	5(50)	2(20)	2(20)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	0.8	1.7	7	5(71)	2(29)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	4.3	10.2	67	26(39)	34(51)	5(7)	1(1)	0(0)	0(0)	1(1)	0(0)	0(0)	1-10
28.	CY:WC-BAY	2.4	5.2	26	13(50)	12(46)	0(0)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
29.	CY:E-UP	3.3	5.3	29	11(38)	14(48)	4(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	5.3	8.9	50	15(30)	28(56)	4(8)	1(2)	2(4)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	4.8	6.9	30	11(37)	15(50)	2(7)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	6.2	11.1	20	6(30)	11(55)	1(5)	1(5)	1(5)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	7.2	7.1	11	1(9)	7(64)	2(18)	1(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	8.7	11.9	6	2(33)	2(33)	0(0)	2(33)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	5.8	11.1	35	10(29)	19(54)	4(11)	0(0)	1(3)	1(3)	0(0)	0(0)	0(0)	1-10
36.	CY:GWB	4.5	7.4	29	7(24)	18(62)	3(10)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	4.1	7.8	52	21(40)	23(44)	5(10)	3(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	4.3	5.5	22	7(32)	12(55)	3(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	6.0	8.9	20	3(15)	13(65)	2(10)	2(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	6.0	10.9	44	8(18)	31(70)	0(0)	3(7)	1(2)	1(2)	0(0)	0(0)	0(0)	1-10
41.	TR	**15.2**	**20.6**	109	6(6)	51(47)	32(29)	7(6)	6(6)	5(5)	0(0)	1(1)	1(1)	1-10
42.	TW	8.3	11.6	43	10(23)	20(47)	7(16)	3(7)	2(5)	1(2)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	8.1	12.2	11	3(27)	4(36)	3(27)	0(0)	1(9)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	**27.6**	**22.8**	3	0(0)	1(33)	0(0)	1(33)	1(33)	0(0)	0(0)	0(0)	0(0)	1-10
45.	LO:E-UP +TR	**31.7**	**16.8**	11	1(9)	0(0)	1(9)	5(45)	3(27)	1(9)	0(0)	0(0)	0(0)	21-35
46.	LO:BHR +TR	**14.2**	**10.7**	6	1(17)	1(17)	3(50)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
47.	LO:JRK +TR	**20.2**	**22.8**	13	0(0)	5(38)	5(38)	1(8)	0(0)	1(8)	0(0)	1(8)	0(0)	11-20
48.	LO:ORS +TR	**18.3**	**20.9**	9	1(11)	4(44)	1(11)	1(11)	1(11)	1(11)	0(0)	0(0)	0(0)	1-10
49.	LO:CTS +TR	7.6	9.5	8	3(38)	3(38)	1(13)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	**14.9**	**19.6**	10	1(10)	3(30)	4(40)	1(10)	0(0)	0(0)	1(10)	0(0)	0(0)	11-20
51.	LO:GWB +TR	**15.7**	**19.1**	10	0(0)	6(60)	1(10)	1(10)	1(10)	1(10)	0(0)	0(0)	0(0)	1-10
52.	LO:BD +TR	**13.0**	**13.0**	4	1(25)	1(25)	1(25)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
53.	CY:NW-BAY+TR	9.5	8.5	16	0(0)	10(63)	4(25)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**14.1**	**19.1**	23	2(9)	13(57)	3(13)	2(9)	2(9)	0(0)	0(0)	1(4)	0(0)	1-10
55.	CY:BHR+TR	**17.5**	**16.2**	16	2(13)	6(38)	3(19)	2(13)	3(19)	0(0)	0(0)	0(0)	0(0)	1-10
56.	CY:JRK+TR	**12.3**	**11.0**	9	2(22)	3(33)	1(11)	3(33)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	**20.5**	**28.8**	9	0(0)	4(44)	2(22)	2(22)	0(0)	0(0)	0(0)	1(11)	0(0)	11-20
58.	CY:CTS+TR	**13.8**	**16.3**	4	0(0)	3(75)	0(0)	0(0)	1(25)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	7.6	8.9	6	1(17)	3(50)	1(17)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	8.4	7.3	16	0(0)	9(56)	6(38)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	7.0	6.7	9	0(0)	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	8.2	7.2	28	5(18)	12(43)	10(36)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	8.3	11.0	15	2(13)	9(60)	2(13)	1(7)	1(7)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	9.9	11.4	29	4(14)	14(48)	7(24)	2(7)	2(7)	0(0)	0(0)	0(0)	0(0)	1-10
65.	CY:BHR+TW	2.8	2.9	7	2(29)	5(71)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	6.0	4.2	5	1(20)	4(80)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	4.4	5.8	10	1(10)	8(80)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	9.1	8.7	45	2(4)	27(60)	12(27)	3(7)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	7.5	16.5	13	3(23)	8(62)	1(8)	0(0)	0(0)	1(8)	0(0)	0(0)	0(0)	1-10
	Total			1381	367(27)	679(49)	201(15)	82(6)	32(2)	13(1)	2(0)	4(0)	1(0)	

TABLE 6

Same as Table 4 but for Sub-Catchment No. 3

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	0.0	-	1	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
2.	CS:NW-BAY	0.3	0.4	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	7.3	7.1	4	1(25)	1(25)	2(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
4.	DP:NW-BAY	2.8	3.4	15	6(40)	9(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	1.1	1.4	15	8(53)	7(47)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
6.	DP:EC-BAY	0.0	0.0	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	10.9	8.9	5	1(20)	1(20)	2(40)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
8.	DP:BD	33.5	9.2	2	0(0)	0(0)	0(0)	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	21-35
9.	DP:JRK	5.6	6.4	9	0(0)	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	3.2	5.1	14	6(43)	6(43)	2(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	7.8	7.3	8	1(13)	4(50)	3(38)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	2.5	1.4	5	0(0)	5(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	2.8	7.2	12	7(58)	4(33)	0(0)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
14.	LO:NW-BAY	4.3	12.0	115	59(51)	45(39)	7(6)	1(1)	1(1)	0(0)	1(1)	1(1)	0(0)	No rain
15.	LO:EC-BAY	0.2	0.4	9	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	2.8	5.9	40	24(60)	14(35)	0(0)	2(5)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	4.3	3.9	8	2(25)	5(63)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	5.7	4.7	12	1(8)	9(75)	2(17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	5.9	9.7	29	8(28)	17(59)	2(7)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	4.9	6.2	28	6(21)	17(61)	4(14)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	4.7	6.3	33	13(39)	15(45)	4(12)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	5.0	7.8	32	8(25)	18(56)	5(16)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	6.3	10.7	3	2(67)	0(0)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
24.	LO:GWB	6.2	8.3	23	7(30)	10(43)	4(17)	2(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	9.5	18.5	10	3(30)	5(50)	1(10)	0(0)	0(0)	1(10)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	0.3	0.5	7	5(71)	2(29)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	4.1	8.3	67	21(31)	38(57)	6(9)	0(0)	2(3)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	2.3	5.9	26	17(65)	8(31)	0(0)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
29.	CY:E-UP	2.4	4.6	29	17(59)	10(34)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
30.	CY:BHR	7.7	12.9	50	13(26)	28(56)	3(6)	4(8)	1(2)	0(0)	1(2)	0(0)	0(0)	1-10
31.	CY:JRK	4.4	8.9	30	8(27)	20(67)	0(0)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	4.9	6.6	20	5(25)	12(60)	2(10)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	**11.2**	**12.6**	11	0(0)	6(55)	3(27)	1(9)	1(9)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	5.6	6.4	6	0(0)	5(83)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	7.7	11.8	35	7(20)	19(54)	3(9)	4(11)	2(6)	0(0)	0(0)	0(0)	0(0)	1-10
36.	CY:GWB	5.3	10.8	29	6(21)	21(72)	0(0)	0(0)	2(7)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	7.7	11.2	52	17(33)	22(42)	6(12)	5(10)	2(4)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	4.7	5.3	22	7(32)	11(50)	4(18)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	3.7	4.2	20	5(25)	13(65)	2(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	7.6	12.5	44	12(27)	23(52)	3(7)	4(9)	1(2)	1(2)	0(0)	0(0)	0(0)	1-10
41.	TR	**20.0**	**30.5**	109	6(6)	47(44)	25(23)	15(14)	5(5)	3(3)	1(1)	3(3)	4(4)	1-10
42.	TW	9.3	14.6	43	7(16)	26(60)	7(16)	1(2)	0(0)	0(0)	2(5)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	**10.9**	**15.3**	11	2(18)	6(55)	1(9)	0(0)	2(18)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	**25.1**	**22.1**	3	0(0)	1(33)	0(0)	1(33)	1(33)	0(0)	0(0)	0(0)	0(0)	1-10
45.	LO:E-UP +TR	**41.6**	**25.3**	11	0(0)	1(9)	2(18)	1(9)	2(18)	3(27)	2(18)	0(0)	0(0)	36-50
46.	LO:BHR +TR	**15.5**	**14.3**	6	0(0)	2(33)	2(33)	1(17)	1(17)	0(0)	0(0)	0(0)	0(0)	11-20
47.	LO:JRK +TR	**21.8**	**16.6**	13	0(0)	4(31)	3(23)	4(31)	1(8)	1(8)	0(0)	0(0)	0(0)	11-20
48.	LO:ORS +TR	**28.7**	**30.1**	9	0(0)	3(33)	3(33)	0(0)	0(0)	1(11)	2(22)	0(0)	0(0)	11-20
49.	LO:CTS +TR	**15.6**	**21.9**	8	2(25)	3(38)	1(13)	0(0)	1(13)	1(13)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	10.0	7.2	10	1(10)	3(30)	5(50)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
51.	LO:GWB +TR	**12.6**	**13.0**	10	0(0)	6(60)	2(20)	1(10)	1(10)	0(0)	0(0)	0(0)	0(0)	1-10
52.	LO:BD +TR	**11.3**	**13.8**	4	1(25)	1(25)	1(25)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
53.	CY:NW-BAY+TR	9.0	6.9	16	1(6)	8(50)	6(38)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**17.7**	**20.5**	23	1(4)	12(52)	3(13)	4(17)	2(9)	0(0)	0(0)	1(4)	0(0)	1-10
55.	CY:BHR+TR	**22.1**	**20.2**	16	0(0)	6(38)	2(13)	4(25)	3(19)	0(0)	1(6)	0(0)	0(0)	11-20
56.	CY:JRK+TR	**28.4**	**26.3**	9	0(0)	3(33)	2(22)	0(0)	2(22)	1(11)	1(11)	0(0)	0(0)	11-20
57.	CY:ORS+TR	**19.8**	**27.4**	9	0(0)	4(44)	3(33)	1(11)	0(0)	0(0)	0(0)	1(11)	0(0)	11-20
58.	CY:CTS+TR	11.2	3.8	4	0(0)	1(25)	3(75)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
59.	CY:E-MP+TR	**14.4**	**15.1**	6	1(17)	2(33)	1(17)	2(33)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	5.6	4.5	16	0(0)	14(88)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	7.2	7.4	9	1(11)	6(67)	1(11)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	9.2	9.3	28	2(7)	17(61)	7(25)	1(4)	1(4)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	6.8	7.4	15	0(0)	12(80)	1(7)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	**15.1**	**21.4**	29	6(21)	11(38)	6(21)	2(7)	2(7)	1(3)	0(0)	1(3)	0(0)	1-10
65.	CY:BHR+TW	3.7	4.3	7	2(29)	4(57)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	**11.3**	**16.3**	5	2(40)	1(20)	1(20)	0(0)	1(20)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	7.7	7.1	10	0(0)	8(80)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	**17.8**	**17.4**	45	3(7)	17(38)	9(20)	7(16)	6(13)	3(7)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	**13.1**	**29.8**	13	3(23)	6(46)	3(23)	0(0)	0(0)	0(0)	0(0)	0(0)	1(8)	1-10
	Total			1381	355(26)	676(49)	182(13)	84(6)	46(3)	16(1)	11(1)	7(1)	5(0)	

occasion (50%), (*ii*) Trough passing through NER in association with Low over East UP for 3 (27%) occasions and (*iii*) Trough passing through NER in association with CYCIR over Bihar for 4(25%) occasions.

(f) There were six most important systems favourable (25% or more) producing AAP in the range 36-50 mm or more. Those were (*i*) Depression over Bangladesh for single occasion (50%), (*ii*) Trough passing through NER in association with Low over East UP, Jharkhand and Bangladesh for 5 (45%), 6 (46%) and 1 (25%) occasions respectively and (*iii*)Trough passing through NER in association with CYCIR over Bihar, Jharkhand for 5 (31%) and 3 (33%) occasions respectively.

5.2. *Sub-Catchment No. 2*

The detailed summary is shown in Table 5. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 367 days (27%), (*ii*) 1-10 mm for 679 days (49%), (*iii*) 11-20 mm for 201 days (14%), (*iv*) remaining days were in the range of 21-35 mm and more (*v*) 21-35 mm for 82 days (6%) and (*vi*) remaining 52 days (4%) were in the range 36-50 mm and more.

(b) Four most important synoptic systems fovourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Cyclonic Storm over NE Bay for a single occasion (100%), (*ii*) Depression over East-Central Bay for twice (100%) and (*iii*) Low over East-Central Bay for 8 (89%) occasions and CYCIR over NE Bay for 5(71%) occasions.

(c) Eighteen (18) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Cyclonic Storm over WC Bay for 3(75%) occasions, (*ii*) Depression over Jharkhand, Chhatisgarh and East MP respectively for 8(89%), 5(63%) and 4(80%) occasions, (*iii*) Low over East UP and East MP respectively for 6 (75%) and 20(63%) occasions, (*iv*) CYCIR over Chhattisgarh, GWB, Central Assam and NE Assam for 7(64%), 18(62%), 13(65%) and 31(70%) occasions respectively, (*v*) Trough passing through NER in association with Low over GWB for 6 (60%) occasions, (*vi*) Trough passing through NER in association with CYCIR over NW Bay, Chhattisgarh, GWB and West Assam for 10(63%), 3(75%), 7(78%) and 9(60%) occasions respectively, (*vii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over Bihar, GWB and NE Assam for 5 (71%), 4(80%) and 8(80%) occasions respectively, (*viii*) Trough passing through NER in association with Trough in Westerlies between 85° E - 89° E north of 20° N for 27 (60%) cases and (*ix*) CYCIR over NW Bay in combination with another CYCIR over NE Assam for 8 (62%) cases.

(d) There were four most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Depression over GWB and Bangladesh for 3 (60%) and 1 (50%) occasions and (*ii*) Trough passing through NER in association with Low over Bihar and East MP for 3(50%) and 4(40%) occasions.

(e) There were seven most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Depression over Bangladesh for single occasion (50%), (*ii*) Low over SHWB for twice (67%), (*iii*) CYCIR over East MP for 2(33%), (*iv*) Trough passing through NER in association with Low over West-Central Bay, East UP and Bangladesh for 1(33%), 5(45%) and 1(25%) occasions respectively and (*v*) Trough passing through NER in association with CYCIR over Jharkhand for 3(33%) occasions.

(f) There were three most important systems favourable (25% or more) producing AAP in the range 36-50 mm or more. Those were (*i*) Trough passing through NER in association with Low over WC Bay and East UP for 1(33%) and 4(36%) occasions respectively and (*ii*) Trough passing through NER in association with CYCIR over Chhattisgarh for 1(25%) occasions.

5.3. *Sub-Catchment No. 3*

The detailed summary is shown in Table 6. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 355 days (26%), (*ii*) 1-10 mm for 676 days (49%), (*iii*) 11-20 mm for 182 days (13%), (*iv*) remaining days were in the range of 21-35 mm and more, (*v*) 21-35 mm for 84 days (6%) and (*vi*) remaining 85 days (6%) were in the range 36-50 mm and more.

(b) Seven most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Cyclonic Storm over NE Bay for a single occasion (100%), (*ii*) Depression over East-Central Bay for twice (100%), (*iii*) Low over East-Central Bay and WC Bay for 7(78%) and 24(60%) occasions respectively, (*iv*) Low over SHWB for 2(67%) occasions and (*v*) CYCIR over NE Bay and WC Bay for 5(71%) and 17(65%) occasions respectively.

(c) Twenty one (21) most important synoptic systems favourable (60% or more cases) for producing AAP of

TABLE 7

Same as Table 4 but for Sub-Catchment No. 4

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	0.1	-	1	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
2.	CS:NW-BAY	2.4	3.4	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	**13.7**	**10.0**	4	0(0)	2(50)	1(25)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	6.8	8.5	15	5(33)	5(33)	4(27)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	4.8	8.3	15	6(40)	7(47)	0(0)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.0	0.0	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	**15.3**	**10.7**	5	0(0)	2(40)	1(20)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
8.	DP:BD	21.6	4.9	2	0(0)	0(0)	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
9.	DP:JRK	8.2	8.8	9	1(11)	5(56)	2(22)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	**11.0**	**13.2**	14	4(29)	5(36)	0(0)	5(36)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	11.2	5.8	8	0(0)	3(38)	4(50)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
12.	DP:E-MP	3.2	2.7	5	1(20)	4(80)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	4.1	5.9	12	6(50)	4(33)	2(17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
14.	LO:NW-BAY	7.5	12.7	115	48(42)	45(39)	7(6)	9(8)	2(2)	4(3)	0(0)	0(0)	0(0)	No rain
15.	LO:EC-BAY	1.0	2.3	9	6(67)	3(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	5.5	8.4	40	18(45)	13(33)	7(18)	2(5)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	5.4	4.7	8	2(25)	5(63)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	8.0	7.3	12	1(8)	6(50)	5(42)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	9.2	13.1	29	11(38)	10(34)	4(14)	2(7)	2(7)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	7.1	8.6	28	5(18)	16(57)	5(18)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	9.3	12.5	33	9(27)	13(39)	8(24)	2(6)	0(0)	1(3)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	**14.0**	**18.4**	32	5(16)	16(50)	3(9)	3(9)	3(9)	0(0)	2(6)	0(0)	0(0)	1-10
23.	LO:SHWB	4.9	8.4	3	2(67)	0(0)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
24.	LO:GWB	**10.3**	**13.9**	23	8(35)	5(22)	8(35)	0(0)	1(4)	1(4)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	4.5	6.0	10	4(40)	4(40)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	4.9	9.4	7	4(57)	2(29)	0(0)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	7.0	10.1	67	16(24)	36(54)	7(10)	7(10)	0(0)	1(1)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	5.0	6.6	26	11(42)	12(46)	2(8)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
29.	CY:E-UP	5.7	10.7	29	13(45)	11(38)	2(7)	2(7)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	9.5	15.3	50	12(24)	22(44)	11(22)	2(4)	2(4)	0(0)	0(0)	1(2)	0(0)	1-10
31.	CY:JRK	6.4	9.3	30	8(27)	16(53)	4(13)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	6.8	7.6	20	4(20)	12(60)	1(5)	3(15)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	11.4	8.2	11	1(9)	3(27)	5(45)	2(18)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
34.	CY:E-MP	7.6	11.8	6	1(17)	4(67)	0(0)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	6.4	11.4	35	6(17)	25(71)	2(6)	0(0)	1(3)	1(3)	0(0)	0(0)	0(0)	1-10
36.	CY:GWB	7.0	8.0	29	6(21)	14(48)	7(24)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	6.9	8.8	52	13(25)	27(52)	6(12)	5(10)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	5.6	7.5	22	7(32)	10(45)	4(18)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	9.0	9.9	20	4(20)	9(45)	4(20)	3(15)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	8.0	9.6	44	6(14)	28(64)	6(14)	3(7)	0(0)	1(2)	0(0)	0(0)	0(0)	1-10
41.	TR	**13.8**	**10.3**	109	6(6)	45(41)	31(28)	25(23)	2(2)	0(0)	0(0)	0(0)	0(0)	11-20
42.	TW	**11.2**	**12.9**	43	7(16)	21(49)	4(9)	9(21)	1(2)	1(2)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	**11.9**	**13.0**	11	2(18)	4(36)	3(27)	1(9)	1(9)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	**15.8**	**14.3**	3	0(0)	1(33)	1(33)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
45.	LO:E-UP +TR	**21.7**	**22.2**	11	1(9)	3(27)	3(27)	2(18)	1(9)	0(0)	1(9)	0(0)	0(0)	11-20
46.	LO:BHR +TR	11.4	7.3	6	0(0)	2(33)	4(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
47.	LO:JRK +TR	**20.5**	**18.5**	13	2(15)	2(15)	2(15)	5(38)	0(0)	2(15)	0(0)	0(0)	0(0)	21-35
48.	LO:ORS +TR	**14.8**	**13.2**	9	1(11)	3(33)	2(22)	2(22)	1(11)	0(0)	0(0)	0(0)	0(0)	11-20
49.	LO:CTS +TR	9.6	8.1	8	2(25)	3(38)	2(25)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	**12.8**	**11.7**	10	0(0)	6(60)	2(20)	1(10)	1(10)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	**16.2**	**12.2**	10	0(0)	5(50)	2(20)	2(20)	1(10)	0(0)	0(0)	0(0)	0(0)	1-10
52.	LO:BD +TR	8.4	9.8	4	1(25)	2(50)	0(0)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
53.	CY:NW-BAY+TR	12.9	9.9	16	0(0)	8(50)	6(38)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**12.6**	**10.8**	23	1(4)	11(48)	6(26)	4(17)	1(4)	0(0)	0(0)	0(0)	0(0)	1-10
55.	CY:BHR+TR	**15.7**	**17.4**	16	0(0)	7(44)	6(38)	2(13)	0(0)	0(0)	1(6)	0(0)	0(0)	11-20
56.	CY:JRK+TR	**12.2**	**16.4**	9	0(0)	6(67)	1(11)	1(11)	1(11)	0(0)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	**24.3**	**17.8**	9	0(0)	2(22)	3(33)	2(22)	0(0)	2(22)	0(0)	0(0)	0(0)	11-20
58.	CY:CTS+TR	**18.2**	**14.1**	4	0(0)	2(50)	1(25)	0(0)	1(25)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	**11.4**	**15.8**	6	0(0)	4(67)	1(17)	0(0)	1(17)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	11.4	8.2	16	1(6)	7(44)	5(31)	3(19)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	8.1	6.1	9	0(0)	6(67)	3(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	**13.2**	**12.8**	28	3(11)	12(43)	7(25)	4(14)	2(7)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	7.4	8.0	15	0(0)	13(87)	1(7)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	**10.4**	**10.3**	29	3(10)	13(45)	9(31)	2(7)	2(7)	0(0)	0(0)	0(0)	0(0)	1-10
65.	CY:BHR+TW	4.4	6.8	7	1(14)	5(71)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	**14.9**	**17.7**	5	1(20)	2(40)	1(20)	0(0)	1(20)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	9.7	16.7	10	1(10)	7(70)	1(10)	0(0)	0(0)	1(10)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	**10.9**	**11.2**	45	3(7)	25(56)	10(22)	6(13)	0(0)	1(2)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	10.5	6.9	13	1(8)	5(38)	6(46)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
	Total			1381	295(21)	637(46)	251(18)	146(11)	31(2)	16(1)	4(0)	1(0)	0(0)	

"1-10" mm were (*i*) Depression over NW Bay, Jharkhand and East MP respectively for 9 (60%), 7 (78%) and 5(100%) occasions, (*ii*) Low over East UP, Bihar, Orissa respectively for 5 (63%), 9 (75%) and 17 (61%) occasions respectively, (*iii*) CYCIR over Jharkhand, Orissa, East Madhya Pradesh, GWB and Central Assam for 20 (67%), 12 (60%), 5 (83%), 21 (72%) and 13 (65%) occasions respectively, (*iv*)Trough in Westerlies between 85° E - 89° E north of 20° N for 26 (60%) cases, (*v*) Trough passing through NER in association with Low over GWB for 6 (60%) occasions, (*vi*) Trough passing through NER in association with CYCIR over SHWB, GWB, Bangladesh and West Assam for 14 (88%), 6 (67%), 17 (61%) and 12 (80%) occasions respectively and (*vii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over NE Assam for 8 (80%) occasions.

(d) There were four most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Cyclonic Storm over West-Central Bay for two occasions (50%), (*ii*) Depression over GWB for 2(40%) occasions, (*iii*) Trough passing through NER in association with Low over East MP for 5(50%) and (*iv*) Trough passing through NER in association with CYCIR over Chhattisgarh for 3(75%) occasions.

(e) There were seven most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Depression over Bangladesh for single occasion (50%), (*ii*) Trough passing through NER in association with Low over West- Central Bay, Jharkhand and Bangladesh respectively for 1 (33%), 4 (31%) and 1 (25%) and (*iii*) Trough passing through NER in association with CYCIR over Bihar and East MP for 4 (25%) and 2 (33%) occasions respectively.

(f) There were seven most important systems favourable (25% or more) producing AAP in the range 36-50 mm or more. Those were (*i*) Depression over Bangladesh for single occasion (50%), (*ii*) Trough passing through NER in association with Low over WC Bay, East UP, Orissa and Chhattisgarh for 1 (33%), 7 (64%), 3 (33%) and 2 (25%) occasions respectively and (*iii*) Trough passing through NER in association with CYCIR over Bihar and Jharkhand for 4 (25%) and 4 (44%) occasions respectively.

5.4. *Sub-Catchment No. 4*

The detailed summary is shown in Table 7. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 295 days (21%), (*ii*) 1-10 mm for 637 days (46%), (*iii*) 11-20 mm for 251 days (18%) and (iv)remaining days were in the range of 21- 35 mm and more, (*iv*) 21-35 mm for 146 days (11%) and (*v*) remaining 52 days (4%) were in the range 36-50 mm and more.

(b) Four most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Cyclonic Storm over NE Bay for a single occasion (100%), (*ii*) Depression over East-Central Bay for twice (100%) and (*iii*) Low over East-Central Bay and SHWB respectively for 6 (67%) and 2 (67%) occasions.

(c) Thirteen (13) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Depression over East MP for 4 (80%) occasions, (*ii*) Low over East UP for 5 (63%) occasions, (*iii*) CYCIR over Orissa, East Madhya Pradesh, SHWB and NE Assam respectively for 12 (60%), 4 (67%), 25 (71%) and 28 (64%) occasions, (*iv*)Trough passing through NER in association with Low over East MP for 6 (60%) occasions, (*v*) Trough passing through NER in association with CYCIR over East Madhya Pradesh, Jharkhand, GWB and West Assam for 4 (67%), 6 (67%), 6 (67%) and 13 (87%) occasions respectively and (*vi*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over Bihar and NE Assam for 5 (71%) and 7 (70%) occasions respectively.

(d) There were two most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Depression over Chhattisgarh and Bangladesh respectively for 4 (50%) and 1 (50%) occasions, (*ii*) CYCIR over Chhattisgarh for 5 (45%) occasions, (*iii*) Trough passing through NER in association with Low over Bihar for 4 (67%) occasions and (*iv*) CYCIR over NW Bay in combination with another CYCIR over NE Assam for 6(46%) cases.

(e) There were seven most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Cyclonic Storm over WC Bay for a single occasion (25%), (*ii*) Depression over Orissa, GWB and Bangladesh respectively for 5 (36%), 2 (40%) and 1 (50%) occasions and (*iii*) Trough passing through NER in association with Low over WC Bay, Jharkhand and Bangladesh respectively for 1 (33%), 5 (38%) and 1 (25%) occasions.

(f) There was one most important system favourable (25% or more) producing AAP in the range 36-50 mm or more. This was Trough passing through NER in association with CYCIR over Chhattisgarh for 1 (25%) occasions.

TABLE 8

Same as Table 4 but for Sub-Catchment No. 5

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	0.7	-	1	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
2.	CS:NW-BAY	1.7	2.3	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	**11.3**	**16.1**	4	0(0)	3(75)	0(0)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	3.3	4.1	15	7(47)	7(47)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	3.2	4.1	15	6(40)	8(53)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.1	0.1	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	**14.6**	**12.4**	5	0(0)	2(40)	1(20)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
8.	DP:BD	**29.6**	**13.9**	2	0(0)	0(0)	1(50)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	11-20
9.	DP:JRK	6.3	11.0	9	1(11)	7(78)	0(0)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	5.8	6.4	14	2(14)	10(71)	2(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	5.0	5.7	8	1(13)	6(75)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	3.9	2.8	5	1(20)	4(80)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	2.9	4.0	12	6(50)	5(42)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
14.	LO:NW-BAY	5.8	12.7	115	45(39)	55(48)	8(7)	1(1)	3(3)	1(1)	2(2)	0(0)	0(0)	1-10
15.	LO:EC-BAY	0.4	0.8	9	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	3.5	6.7	40	21(53)	15(38)	1(3)	3(8)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	4.6	5.7	8	3(38)	4(50)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	7.3	10.7	12	3(25)	7(58)	0(0)	2(17)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	7.0	10.1	29	8(28)	17(59)	1(3)	2(7)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	5.7	7.3	28	7(25)	17(61)	3(11)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	6.1	7.0	33	7(21)	19(58)	6(18)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	4.5	5.9	32	7(22)	24(75)	0(0)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	7.4	8.5	3	1(33)	1(33)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
24.	LO:GWB	6.5	9.8	23	7(30)	11(48)	3(13)	2(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	1.9	2.8	10	6(60)	4(40)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
26.	CY:NE-BAY	1.7	3.4	7	5(71)	2(29)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	5.0	7.9	67	21(31)	36(54)	8(12)	1(1)	0(0)	1(1)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	2.6	4.4	26	14(54)	10(38)	2(8)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
29.	CY:E-UP	6.2	11.9	29	15(52)	10(34)	1(3)	1(3)	2(7)	0(0)	0(0)	0(0)	0(0)	No rain
30.	CY:BHR	6.4	6.5	50	12(24)	27(54)	8(16)	3(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	4.9	8.3	30	12(40)	14(47)	2(7)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	3.8	4.3	20	3(15)	15(75)	2(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	7.4	7.9	11	3(27)	5(45)	2(18)	1(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	3.1	2.3	6	0(0)	6(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	6.4	8.4	35	6(17)	21(60)	5(14)	3(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
36.	CY:GWB	5.5	5.4	29	3(10)	23(79)	2(7)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	8.7	9.6	52	9(17)	27(52)	11(21)	4(8)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	4.4	4.1	22	5(23)	16(73)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	4.2	6.0	20	5(25)	12(60)	2(10)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	**13.3**	**21.4**	44	5(11)	23(52)	9(20)	3(7)	1(2)	0(0)	1(2)	2(5)	0(0)	1-10
41.	TR	**13.8**	**12.8**	109	6(6)	54(50)	24(22)	17(16)	6(6)	2(2)	0(0)	0(0)	0(0)	1-10
42.	TW	9.9	10.0	43	5(12)	23(53)	9(21)	5(12)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	9.5	12.9	11	2(18)	6(55)	0(0)	3(27)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	8.1	4.9	3	0(0)	2(67)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
45.	LO:E-UP +TR	**19.8**	**17.9**	11	0(0)	4(36)	2(18)	4(36)	0(0)	1(9)	0(0)	0(0)	0(0)	11-20
46.	LO:BHR +TR	10.1	7.5	6	0(0)	3(50)	2(33)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
47.	LO:JRK +TR	**15.3**	**12.3**	13	1(8)	6(46)	1(8)	5(38)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
48.	LO:ORS +TR	**20.6**	**19.7**	9	0(0)	3(33)	3(33)	1(11)	1(11)	1(11)	0(0)	0(0)	0(0)	11-20
49.	LO:CTS +TR	**21.9**	**21.9**	8	0(0)	4(50)	0(0)	2(25)	1(13)	1(13)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	6.4	5.8	10	0(0)	8(80)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	**14.9**	**15.6**	10	0(0)	6(60)	1(10)	2(20)	1(10)	0(0)	0(0)	0(0)	0(0)	1-10
52.	LO:BD +TR	**17.0**	**21.0**	4	2(50)	0(0)	0(0)	1(25)	1(25)	0(0)	0(0)	0(0)	0(0)	No rain
53.	CY:NW-BAY+TR	**11.7**	**14.5**	16	0(0)	10(63)	4(25)	0(0)	1(6)	1(6)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**13.8**	**14.8**	23	4(17)	10(43)	3(13)	4(17)	1(4)	1(4)	0(0)	0(0)	0(0)	1-10
55.	CY:BHR+TR	**16.5**	**10.7**	16	0(0)	5(31)	7(44)	3(19)	1(6)	0(0)	0(0)	0(0)	0(0)	11-20
56.	CY:JRK+TR	**19.3**	**18.4**	9	0(0)	4(44)	1(11)	3(33)	0(0)	1(11)	0(0)	0(0)	0(0)	11-20
57.	CY:ORS+TR	**20.8**	**19.4**	9	0(0)	3(33)	3(33)	2(22)	0(0)	0(0)	1(11)	0(0)	0(0)	11-20
58.	CY:CTS+TR	6.9	5.2	4	0(0)	3(75)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	**19.9**	**18.7**	6	0(0)	3(50)	0(0)	2(33)	0(0)	1(17)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	8.4	6.8	16	0(0)	12(75)	3(19)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	8.0	4.6	9	1(11)	5(56)	3(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	**12.7**	**11.8**	28	3(11)	13(46)	5(18)	5(18)	2(7)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	6.3	4.9	15	1(7)	11(73)	3(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	**10.7**	**11.6**	29	3(10)	15(52)	7(24)	3(10)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
65.	CY:BHR+TW	8.5	5.7	7	0(0)	6(86)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	8.7	8.5	5	1(20)	2(40)	1(20)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	**12.1**	**10.5**	10	1(10)	5(50)	2(20)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	**14.0**	**11.9**	45	0(0)	22(49)	13(29)	6(13)	3(7)	1(2)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	8.3	8.4	13	2(15)	7(54)	3(23)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
	Total			1381	299(22)	732(53)	192(14)	110(8)	30(2)	12(1)	4(0)	2(0)	0(0)	

TABLE 9

Same as Table 4 but for Sub-Catchment No. 6

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	0.1	-	1	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
2.	CS:NW-BAY	1.1	1.5	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	**14.9**	**15.1**	4	0(0)	2(50)	1(25)	0(0)	1(25)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	6.7	8.0	15	5(33)	6(40)	2(13)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	5.1	7.8	15	6(40)	7(47)	1(7)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.0	0.0	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	13.0	7.9	5	0(0)	2(40)	2(40)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
8.	DP:BD	21.5	2.5	2	0(0)	0(0)	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
9.	DP:JRK	**10.4**	**10.5**	9	1(11)	4(44)	3(33)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	7.8	9.2	14	4(29)	6(43)	3(21)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	8.8	7.8	8	1(13)	3(38)	4(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
12.	DP:E-MP	6.8	6.8	5	0(0)	3(60)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	6.5	9.0	12	5(42)	3(25)	2(17)	2(17)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
14.	LO:NW-BAY	6.5	9.5	115	39(34)	53(46)	11(10)	10(9)	2(2)	0(0)	0(0)	0(0)	0(0)	1-10
15.	LO:EC-BAY	1.3	3.0	9	6(67)	3(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	5.2	7.9	40	16(40)	15(38)	7(18)	2(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
17.	LO:E-UP	6.7	6.2	8	2(25)	4(50)	2(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	7.3	6.3	12	0(0)	9(75)	2(17)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	8.2	11.1	29	8(28)	14(48)	3(10)	2(7)	2(7)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	6.3	6.6	28	4(14)	17(61)	6(21)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	7.5	7.6	33	4(12)	22(67)	5(15)	2(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	8.2	8.9	32	7(22)	16(50)	5(16)	4(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	**13.6**	**14.9**	3	1(33)	0(0)	1(33)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
24.	LO:GWB	7.7	9.3	23	5(22)	12(52)	4(17)	2(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	3.0	2.9	10	4(40)	6(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	3.4	8.0	7	4(57)	2(29)	0(0)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	6.0	6.7	67	16(24)	41(61)	6(9)	4(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	2.9	4.2	26	9(35)	14(54)	3(12)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
29.	CY:E-UP	4.4	5.1	29	9(31)	16(55)	4(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	8.2	9.9	50	5(10)	33(66)	7(14)	4(8)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	5.9	7.7	30	10(33)	16(53)	3(10)	0(0)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	6.0	7.6	20	3(15)	15(75)	0(0)	2(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	10.8	9.3	11	1(9)	5(45)	3(27)	2(18)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	3.1	1.7	6	0(0)	6(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	4.8	5.6	35	6(17)	26(74)	2(6)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
36.	CY:GWB	6.5	6.3	29	3(10)	18(62)	8(28)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	6.1	5.5	52	4(8)	38(73)	9(17)	1(2)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	5.5	6.5	22	3(14)	16(73)	2(9)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	6.8	6.5	20	3(15)	12(60)	5(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	9.0	8.8	44	4(9)	25(57)	10(23)	4(9)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
41.	TR	10.7	8.8	109	5(5)	58(53)	33(30)	12(11)	1(1)	0(0)	0(0)	0(0)	0(0)	1-10
42.	TW	10.1	9.9	43	2(5)	24(56)	11(26)	5(12)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	11.7	9.6	11	1(9)	5(45)	3(27)	2(18)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	7.4	7.7	3	0(0)	2(67)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
45.	LO:E-UP +TR	**15.1**	**12.4**	11	0(0)	5(45)	3(27)	1(9)	2(18)	0(0)	0(0)	0(0)	0(0)	11-20
46.	LO:BHR +TR	13.2	6.1	6	0(0)	3(50)	2(33)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
47.	LO:JRK +TR	**16.5**	**13.4**	13	0(0)	6(46)	2(15)	3(23)	2(15)	0(0)	0(0)	0(0)	0(0)	11-20
48.	LO:ORS +TR	**15.1**	**14.1**	9	1(11)	3(33)	3(33)	1(11)	1(11)	0(0)	0(0)	0(0)	0(0)	11-20
49.	LO:CTS +TR	**12.6**	**10.2**	8	0(0)	3(38)	3(38)	2(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	7.2	3.8	10	0(0)	7(70)	3(30)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	12.9	8.7	10	1(10)	2(20)	5(50)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
52.	LO:BD +TR	9.1	10.0	4	1(25)	1(25)	2(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
53.	CY:NW-BAY+TR	**14.5**	**13.5**	16	0(0)	8(50)	6(38)	0(0)	2(13)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**12.8**	**13.3**	23	1(4)	12(52)	7(30)	1(4)	2(9)	0(0)	0(0)	0(0)	0(0)	1-10
55.	CY:BHR+TR	7.2	4.8	16	1(6)	9(56)	6(38)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
56.	CY:JRK+TR	**14.2**	**14.3**	9	0(0)	5(56)	2(22)	1(11)	1(11)	0(0)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	**20.0**	**12.1**	9	0(0)	3(33)	2(22)	2(22)	2(22)	0(0)	0(0)	0(0)	0(0)	11-20
58.	CY:CTS+TR	12.0	6.8	4	0(0)	1(25)	3(75)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
59.	CY:E-MP+TR	**14.0**	**18.9**	6	0(0)	4(67)	1(17)	0(0)	0(0)	1(17)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	9.2	6.0	16	1(6)	8(50)	7(44)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	9.3	6.1	9	0(0)	6(67)	2(22)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	10.0	7.5	28	1(4)	13(46)	11(39)	3(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	6.4	6.9	15	1(7)	11(73)	2(13)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	8.6	7.2	29	2(7)	17(59)	9(31)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
65.	CY:BHR+TW	3.1	3.8	7	2(29)	4(57)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	**10.8**	**10.7**	5	1(20)	2(40)	1(20)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	6.4	3.9	10	1(10)	6(60)	3(30)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	9.6	9.7	45	1(2)	29(64)	12(27)	2(4)	0(0)	1(2)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	10.0	8.8	13	2(15)	5(38)	4(31)	2(15)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
	Total			1381	227(16)	753(55)	279(20)	98(7)	22(2)	2(0)	0(0)	0(0)	0(0)	

5.5. *Sub-Catchment No. 5*

The detailed summary is shown in Table 8. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 299 days (22%), (*ii*) 1-10 mm for 732 days (53%), (*iii*) 11-20 mm for 192 days (14%), (*iv*) remaining days were in the range of 21-35 mm and more, (*v*) 21-35 mm for 110 days (8%) and (*vi*) remaining 48 days (3%) were in the range 36-50 mm and more.

(b) Four most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Depression over East-Central Bay for twice (100%), (*ii*) Low over East-Central Bay and Bangladesh respectively for 7 (78%) and 6 (60%) occasions and (*iii*) CYCIR over NE Bay for 5 (71%) occasions.

(c) Twenty one (21) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Cyclonic Storm over NE Bay and WC Bay respectively for 1 (100%) and 3 (75%) occasions, (*ii*) Depression over Jharkhand, Orissa, Chhattisgarh and East MP respectively for 7 (78%), 10 (71%), 6 (75%) and 4(80%) occasions, (*iii*) Low over Orissa and East MP respectively for 17 (61%) and 24 (75%) occasions, (*iv*) CYCIR over Orissa, East Madhya Pradesh, SHWB, GWB, West Assam and Central Assam respectively for 15 (75%), 6 (100%), 21 (60%), 23 (79%) 16 (73%) and 12(60%) occasions, (*v*) Trough passing through NER in association with Low over East Madhya Pradesh, GWB and WC Bay respectively for 8 (80%), 6 (60%) and 2 (67%) occasions, (*vi*) Trough passing through NER in association with CYCIR over NW Bay, Chhatisgarh, SHWB, West Assam respectively for 10 (63%), 3 (75%), 12 (75%) and 11 (73%) occasions and (*vii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over Bihar for 6(86%) occasions.

(d) There were two most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Depression over Bangladesh for a single occasion (50%) and (*ii*) Trough passing through NER in association with CYCIR over Bihar for 7(44%) occasions.

(e) There were nine most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Cyclonic Storm over WC Bay for a single occasion (25%), (*ii*) Depression over GWB for 2(40%), (*iii*) Trough passing through NER in association with Low over NW Bay, East UP, Jharkhand, Chhatisgarh and Bangladesh for 3 (27%), 4 (36%), 5 (38%), 2 (25%) and 1 (25%) occasions and (*iv*)Trough passing through NER in association with CYCIR over Jharkhand and East MP for 3 (33%) and 2 (33%) occasions.

(f) There were three most important systems favourable (25% or more) producing AAP in the range 36-50 mm or more. Those were (*i*) Depression over Bangladesh for single occasion (50%) and (*ii*) Trough passing through NER in association with Low over Bangladesh and Chhattisgarh for 1 (25%) and 2 (25%) occasions respectively.

5.6. *Sub-Catchment No. 6*

The detailed summary is shown in Table 9. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 227 days (16%), (*ii*) 1-10 mm for 753 days (55%), (*iii*) 11-20 mm for 279 days (20%), (*iv*) remaining days were in the range of 21-35 mm and more, (*v*) 21-35 mm for 98 days (7%) and (*vi*) remaining 24 days (2%) were in the range 36-50 mm and more.

(b) Three most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Cyclonic Storm over NE Bay for a single occasion (100%), (*ii*) Depression over East-Central Bay for twice (100%) and (*iii*)Low over East-Central Bay for 6(67%) occasions.

(c) Twenty one (21) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Depression over East MP respectively for 3 (60%) occasions, (*ii*) Low over Bihar, Orissa, Chhattisgarh and Bangladesh respectively for 9 (75%), 17 (61%), 22 (67%) and 6 (60%) occasions, (*iii*) CYCIR over North-West Bay, Bihar, Orissa, East Madhya Pradesh, SHWB, GWB, Bangladesh, West Assam and Central Assam respectively for 41 (61%), 33 (66%), 15 (75%), 6 (100%), 26(74%), 18 (62%), 38 (73%), 16 (73%) and 12 (60%) occasions, (*iv*) Trough passing through NER in association with Low over East MP and WC Bay respectively for 7(70%) and 2(67%) occasions, (*v*) Trough passing through NER in association with CYCIR over East Madhya Pradesh, GWB and West Assam respectively for 4(67%), 6(67%) and 11(73%) occasions respectively, (*vi*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over NE Assam for 6 (60%) occasions and (*vii*) Trough passing through NER in association with Trough in Westerlies between 85° E - 89° E north of 20° N for 29 (64%).

(d) There were eight most important systems favourable (40% or more) producing AAP in the range 11-20 mm.

TABLE 10

Same as Table 4 but for Sub-Catchment No. 7

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	0.0	-	1	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
2.	CS:NW-BAY	**10.4**	**14.5**	2	1(50)	0(0)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	3.4	2.1	4	0(0)	4(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	5.2	9.6	15	7(47)	5(33)	2(13)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
5.	DP:WC-BAY	2.5	3.3	15	6(40)	9(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.0	0.0	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	3.1	1.8	5	0(0)	5(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
8.	DP:BD	**14.0**	**10.9**	2	0(0)	1(50)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
9.	DP:JRK	3.4	4.3	9	2(22)	6(67)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	3.3	5.5	14	3(21)	9(64)	2(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	4.9	8.8	8	1(13)	6(75)	0(0)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	3.5	1.4	5	0(0)	5(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	2.9	4.0	12	4(33)	7(58)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
14.	LO:NW-BAY	4.7	9.4	115	46(40)	55(48)	7(6)	2(2)	5(4)	0(0)	0(0)	0(0)	0(0)	1-10
15.	LO:EC-BAY	0.6	0.9	9	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	3.1	5.0	40	18(45)	20(50)	2(5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
17.	LO:E-UP	2.8	3.0	8	3(38)	5(63)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	2.6	4.2	12	2(17)	9(75)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	4.6	6.9	29	10(34)	14(48)	4(14)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	3.6	5.2	28	9(32)	17(61)	1(4)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	5.9	9.3	33	13(39)	14(42)	3(9)	2(6)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	3.1	4.5	32	14(44)	15(47)	3(9)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	7.0	10.7	3	1(33)	1(33)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
24.	LO:GWB	6.2	9.6	23	7(30)	12(52)	1(4)	3(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	3.6	4.3	10	4(40)	5(50)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	5.0	8.7	7	4(57)	2(29)	0(0)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	4.5	6.5	67	21(31)	35(52)	9(13)	1(1)	1(1)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	4.2	6.6	26	9(35)	14(54)	2(8)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
29.	CY:E-UP	2.1	3.4	29	13(45)	14(48)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	4.1	7.7	50	18(36)	27(54)	4(8)	0(0)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	3.5	6.0	30	13(43)	14(47)	2(7)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	3.0	2.3	20	6(30)	14(70)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	8.2	11.3	11	3(27)	5(45)	1(9)	2(18)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	6.3	8.0	6	0(0)	4(67)	2(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	3.8	5.6	35	11(31)	19(54)	4(11)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
36.	CY:GWB	3.9	5.7	29	5(17)	22(76)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	4.0	5.8	52	15(29)	33(63)	2(4)	2(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	3.3	4.7	22	6(27)	13(59)	3(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	8.5	9.4	20	3(15)	11(55)	4(20)	1(5)	1(5)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	6.3	9.0	44	11(25)	24(55)	4(9)	4(9)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
41.	TR	6.2	8.5	109	16(15)	74(68)	13(12)	4(4)	1(1)	1(1)	0(0)	0(0)	0(0)	1-10
42.	TW	7.2	15.7	43	13(30)	22(51)	5(12)	2(5)	0(0)	0(0)	0(0)	1(2)	0(0)	1-10
43.	LO:NW-BAY +TR	6.1	6.0	11	2(18)	6(55)	3(27)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	**11.7**	**20.2**	3	2(67)	0(0)	0(0)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
45.	LO:E-UP +TR	5.2	5.2	11	2(18)	6(55)	3(27)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
46.	LO:BHR +TR	4.5	4.8	6	0(0)	5(83)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
47.	LO:JRK +TR	**12.5**	**16.2**	13	4(31)	4(31)	1(8)	2(15)	2(15)	0(0)	0(0)	0(0)	0(0)	1-10
48.	LO:ORS +TR	**18.4**	**18.2**	9	1(11)	3(33)	2(22)	0(0)	3(33)	0(0)	0(0)	0(0)	0(0)	11-20
49.	LO:CTS +TR	5.5	9.8	8	2(25)	5(63)	0(0)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	3.4	3.4	10	1(10)	9(90)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	9.3	7.5	10	1(10)	4(40)	5(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
52.	LO:BD +TR	6.5	7.5	4	1(25)	2(50)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
53.	CY:NW-BAY+TR	6.8	8.1	16	3(19)	8(50)	5(31)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	8.7	13.3	23	3(13)	17(74)	0(0)	2(9)	0(0)	1(4)	0(0)	0(0)	0(0)	1-10
55.	CY:BHR+TR	4.9	4.8	16	0(0)	14(88)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
56.	CY:JRK+TR	7.8	12.0	9	2(22)	5(56)	0(0)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	**10.1**	**17.2**	9	2(22)	5(56)	1(11)	0(0)	0(0)	1(11)	0(0)	0(0)	0(0)	1-10
58.	CY:CTS+TR	3.8	2.2	4	0(0)	4(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	2.5	1.4	6	1(17)	5(83)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	5.2	4.4	16	1(6)	12(75)	3(19)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	4.6	4.0	9	2(22)	6(67)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	**12.1**	**14.0**	28	2(7)	17(61)	3(11)	4(14)	1(4)	1(4)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	3.2	4.3	15	4(27)	9(60)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	3.6	4.2	29	7(24)	19(66)	3(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
65.	CY:BHR+TW	3.1	7.4	7	4(57)	2(29)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
66.	CY:GWB+TW	3.4	5.3	5	3(60)	1(20)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
67.	CY:NE-ASS+TW	3.3	4.3	10	4(40)	5(50)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	4.4	6.0	45	11(24)	31(69)	2(4)	1(2)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	8.8	13.1	13	2(15)	8(62)	1(8)	1(8)	1(8)	0(0)	0(0)	0(0)	0(0)	1-10
	Total			1381	395(29)	785(57)	130(9)	48(3)	18(1)	4(0)	0(0)	1(0)	0(0)	

TABLE 11

Same as Table 4 but for Sub-Catchment No. 8

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	1.0	-	1	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
2.	CS:NW-BAY	2.8	4.0	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	**11.0**	**11.1**	4	1(25)	1(25)	1(25)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	6.7	8.6	15	6(40)	5(33)	3(20)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	4.9	5.6	15	6(40)	6(40)	3(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.0	0.0	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	10.3	8.0	5	0(0)	2(40)	3(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
8.	DP:BD	**23.8**	**17.8**	2	0(0)	0(0)	1(50)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	11-20
9.	DP:JRK	5.7	6.9	9	0(0)	8(89)	0(0)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	5.4	7.4	14	1(7)	11(79)	1(7)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	9.9	9.3	8	0(0)	5(63)	1(13)	2(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	4.4	4.6	5	1(20)	3(60)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	6.7	9.2	12	6(50)	3(25)	1(8)	2(17)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
14.	LO:NW-BAY	4.5	7.5	115	44(38)	57(50)	8(7)	5(4)	1(1)	0(0)	0(0)	0(0)	0(0)	1-10
15.	LO:EC-BAY	1.3	3.1	9	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	3.2	5.0	40	19(48)	17(43)	4(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
17.	LO:E-UP	5.4	7.7	8	2(25)	5(63)	0(0)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	7.5	8.8	12	1(8)	8(67)	2(17)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	5.5	7.3	29	9(31)	15(52)	4(14)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	5.8	5.6	28	5(18)	18(64)	5(18)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	6.2	7.4	33	9(27)	16(48)	7(21)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	4.7	5.2	32	7(22)	21(66)	4(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	7.3	7.2	3	1(33)	1(33)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
24.	LO:GWB	6.7	9.2	23	6(26)	13(57)	2(9)	2(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	2.3	4.3	10	4(40)	5(50)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	1.5	3.7	7	5(71)	2(29)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	6.8	9.3	67	19(28)	33(49)	10(15)	3(4)	2(3)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	2.4	3.8	26	10(38)	15(58)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
29.	CY:E-UP	6.1	10.0	29	11(38)	13(45)	3(10)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	5.8	6.3	50	12(24)	25(50)	11(22)	2(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	5.4	6.2	30	7(23)	16(53)	7(23)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	5.7	7.5	20	1(5)	17(85)	1(5)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	5.8	7.1	11	3(27)	6(55)	1(9)	1(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	4.9	2.9	6	0(0)	6(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	**10.2**	**14.1**	35	7(20)	16(46)	7(20)	3(9)	1(3)	0(0)	1(3)	0(0)	0(0)	1-10
36.	CY:GWB	7.0	6.9	29	4(14)	19(66)	4(14)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	6.4	6.3	52	6(12)	35(67)	9(17)	2(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	4.8	5.5	22	4(18)	16(73)	1(5)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	7.9	8.6	20	3(15)	13(65)	1(5)	3(15)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	**11.5**	**10.7**	44	3(7)	20(45)	16(36)	2(5)	3(7)	0(0)	0(0)	0(0)	0(0)	1-10
41.	TR	**12.1**	**12.2**	109	4(4)	63(58)	22(20)	14(13)	4(4)	1(1)	1(1)	0(0)	0(0)	1-10
42.	TW	10.4	8.6	43	5(12)	19(44)	13(30)	5(12)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	**12.0**	**12.4**	11	1(9)	5(45)	4(36)	0(0)	1(9)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	11.1	3.0	3	0(0)	1(33)	2(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
45.	LO:E-UP +TR	**19.3**	**18.9**	11	0(0)	6(55)	2(18)	1(9)	0(0)	2(18)	0(0)	0(0)	0(0)	1-10
46.	LO:BHR +TR	12.2	5.4	6	0(0)	2(33)	4(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
47.	LO:JRK +TR	**22.3**	**23.0**	13	2(15)	3(23)	2(15)	2(15)	3(23)	0(0)	0(0)	1(8)	0(0)	11-20
48.	LO:ORS +TR	**14.0**	**21.0**	9	0(0)	6(67)	1(11)	1(11)	0(0)	1(11)	0(0)	0(0)	0(0)	1-10
49.	LO:CTS +TR	**14.8**	**12.2**	8	0(0)	4(50)	1(13)	3(38)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
50.	LO:E-MP +TR	9.6	13.4	10	0(0)	8(80)	0(0)	1(10)	1(10)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	**17.8**	**15.7**	10	1(10)	3(30)	2(20)	2(20)	2(20)	0(0)	0(0)	0(0)	0(0)	11-20
52.	LO:BD +TR	**12.3**	**18.6**	4	2(50)	1(25)	0(0)	0(0)	1(25)	0(0)	0(0)	0(0)	0(0)	No rain
53.	CY:NW-BAY+TR	8.4	6.8	16	0(0)	12(75)	3(19)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**13.6**	**13.4**	23	0(0)	13(57)	5(22)	3(13)	2(9)	0(0)	0(0)	0(0)	0(0)	1-10
55.	CY:BHR+TR	12.8	8.5	16	0(0)	8(50)	5(31)	3(19)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
56.	CY:JRK+TR	**12.1**	**15.7**	9	0(0)	6(67)	2(22)	0(0)	0(0)	1(11)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	10.0	7.3	9	1(11)	5(56)	2(22)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
58.	CY:CTS+TR	7.1	4.8	4	0(0)	3(75)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	**14.4**	**14.4**	6	0(0)	4(67)	0(0)	1(17)	1(17)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	8.4	5.9	16	1(6)	9(56)	6(38)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	10.2	5.0	9	0(0)	6(67)	3(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	**12.9**	**12.6**	28	2(7)	16(57)	4(14)	4(14)	1(4)	1(4)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	8.3	7.1	15	2(13)	7(47)	5(33)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	**13.2**	**11.1**	29	3(10)	10(34)	9(31)	6(21)	1(3)	0(0)	0(0)	0(0)	0(0)	11-20
65.	CY:BHR+TW	4.1	3.4	7	1(14)	6(86)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	**14.0**	**14.4**	5	1(20)	1(20)	2(40)	0(0)	1(20)	0(0)	0(0)	0(0)	0(0)	11-20
67.	CY:NE-ASS+TW	7.2	6.9	10	2(20)	5(50)	3(30)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	11.3	9.9	45	1(2)	27(60)	10(22)	5(11)	2(4)	0(0)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	9.4	8.9	13	2(15)	6(46)	2(15)	3(23)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
	Total			1381	264(19)	741(54)	240(17)	97(7)	30(2)	6(0)	2(0)	1(0)	0(0)	

Those were (*i*) Depression over GWB, Bangladesh, Chhattisgarh and East MP respectively for 2 (40%), 1 (50%), 4 (50%) and 2 (40%) occasions, (*ii*) Trough passing through NER in association with Low over GWB and Bangladesh respectively for 5(50%) and 2(50%) occasions and (*iii*) Trough passing through NER in association with CYCIR over Chhattisgarh and SHWB respectively for 3 (75%) and 7 (44%) occasions.

(e) There were three most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Depression over Bangladesh for single occasion (50%), (*ii*) Low over SHWB for a single occasion (33%) and (*iii*) Trough passing through NER in association with Low over Chhattisgarh for 2(25%) occasions.

(f) There was one most important system favourable (25% or more) producing AAP in the range 36-50 mm or more. This was Cyclonic Storm over WC Bay for 1(25%) occasions.

5.7. *Sub-Catchment No. 7*

The detailed summary is shown in Table 10. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 395 days (29%), (*ii*) 1-10 mm for 785 days (57%), (*iii*) 11-20 mm for 130 days (9%), (*iv*) remaining days were in the range of 21- 35 mm and more, (*v*) 21-35 mm for 48 days (3%) and (*vi*) remaining 23 days (2%) were in the range 36-50 mm and more

(b) Five most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Cyclonic Storm over NE Bay for a single occasion (100%), (*ii*) Depression over East-Central Bay for twice (100%), (*iii*) Low over East-Central Bay for 7 (78%) occasions, (*iv*) Trough passing through NER in association with Low over WC Bay for 2 (67%) occasions and (*v*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over GWB for 3 (60%) occasions.

(c) Twenty nine (29) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Cyclonic Storm over WC Bay for 4(100%) occasions, (*ii*) Depression over WC Bay, GWB, Jharkhand, Orissa, Chhattisgarh and East MP respectively for 9 (60%), 5 (100%), 6 (67%), 9 (64%), 6 (75%) and 5(100%) occasions, (*iii*) Low over East UP, Bihar and Orissa respectively for 5 (63%), 9 (75%), and 17 (61%) occasions, (*iv*) CYCIR over Orissa, East Madhya Pradesh, GWB and Bangladesh respectively for 14 (70%), 4 (67%), 22 (76%) and 33 (63%) occasions, (*v*) Trough passing through NER for 74 (68%) occasions, (*vi*) Trough passing through NER in association with Low over Bihar, Chhattisgarh and East MP respectively for 5 (83%), 5 (63%) and 9 (90%) occasions, (*vii*) Trough passing through NER in association with CYCIR over East UP, Bihar, Chhattisgarh, East Madhya Pradesh, SHWB, GWB, Bangladesh, West Assam and NE Assam respectively for 17 (74%), 14 (88%), 4 (100%), 5 (83%), 12 (75%), 6 (67%), 17 (61%), 9 (60%) and 19 (66%) occasions, (*viii*) Trough passing through NER in association with Trough in Westerlies between 85° E - 89° E north of 20° N for 31 (69%) and (*ix*) CYCIR over NW Bay in combination with another CYCIR over NE Assam for 8 (62%) cases.

(d) Trough passing through NER in association with Low over GWB for 5 (50%) occasions was the single most important system favourable (40% or more) for producing AAP in the range 11-20 mm.

(e) There were three most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Cyclonic Storm over NW Bay for a single occasion (50%), (*ii*) Depression over Bangladesh for a single occasion (50%) and (*iii*) Trough passing through NER in association with Low over WC Bay for a single occasion (33%).

(f) There was one most important system favourable (25% or more) producing AAP in the range 36-50 mm or more. This was Trough passing through NER in association with Low over Orissa for 3(33%) occasions.

5.8. *Sub-Catchment No. 8*

The detailed summary is shown in Table 11. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 264 days (19%), (*ii*) 1-10 mm for 741 days (54%), (*iii*) 11-20 mm for 240 days (17%), (*iv*) 21-35 mm for 97 days (7%) and (*v*) remaining 39 days (3%) were in the range 36-50 mm and more.

(b) Three most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Depression over East-Central Bay for twice (100%), (*ii*) Low over East-Central Bay for 7(78%) occasions and (*iii*) CYCIR over NE Bay for 5 (71%).

(c) Twenty five (25) most important synoptic systems favourable (60% or more cases) for producing AAP of " 1-10" mm were (*i*) Cyclonic Storm over NE Bay for a

TABLE 12

Same as Table 4 but for Sub-Catchment No. 9

S. No.	System	Mean	S.D.	Freq.	Aap (mm) at different ranges with frequency of occurrence (Probability of occurrence)									F/C range
					Nr	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	5.2	-	1	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
2.	CS:NW-BAY	7.7	10.9	2	1(50)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	7.2	9.1	4	0(0)	3(75)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	4.8	4.4	15	5(33)	8(53)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	5.0	6.6	15	5(33)	8(53)	1(7)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.0	0.0	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	11.1	7.8	5	0(0)	2(40)	3(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
8.	DP:BD	**17.8**	**16.2**	2	0(0)	1(50)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
9.	DP:JRK	4.5	4.3	9	0(0)	8(89)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	4.7	7.4	14	4(29)	8(57)	1(7)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	4.5	4.0	8	2(25)	5(63)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	1.3	0.9	5	1(20)	4(80)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	2.0	2.8	12	7(58)	5(42)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
14.	LO:NW-BAY	5.0	8.7	115	48(42)	47(41)	12(10)	6(5)	2(2)	0(0)	0(0)	0(0)	0(0)	1-10
15.	LO:EC-BAY	1.2	2.4	9	6(67)	3(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	2.7	4.0	40	22(55)	15(38)	3(8)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	5.3	7.9	8	3(38)	4(50)	0(0)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	8.1	8.8	12	1(8)	7(58)	3(25)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	9.0	13.5	29	7(24)	12(41)	7(24)	1(3)	1(3)	1(3)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	5.6	5.7	28	6(21)	18(64)	4(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	5.7	7.0	33	9(27)	18(55)	4(12)	2(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	5.4	5.2	32	7(22)	20(63)	5(16)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	5.1	6.9	3	1(33)	1(33)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
24.	LO:GWB	5.9	8.1	23	6(26)	12(52)	4(17)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	3.7	4.8	10	2(20)	7(70)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	0.1	0.1	7	7(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	5.8	9.3	67	21(31)	37(55)	3(4)	4(6)	2(3)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	5.3	13.7	26	12(46)	11(42)	1(4)	1(4)	0(0)	1(4)	0(0)	0(0)	0(0)	1-10
29.	CY:E-UP	7.8	10.9	29	8(28)	13(45)	4(14)	3(10)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	7.0	7.3	50	13(26)	21(42)	14(28)	2(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	6.2	9.2	30	12(40)	12(40)	5(17)	0(0)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	6.3	7.8	20	4(20)	12(60)	2(10)	2(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	5.5	5.7	11	1(9)	8(73)	2(18)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	3.3	2.1	6	0(0)	6(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	**10.8**	**16.5**	35	6(17)	19(54)	7(20)	0(0)	2(6)	0(0)	1(3)	0(0)	0(0)	1-10
36.	CY:GWB	5.4	8.1	29	6(21)	17(59)	3(10)	3(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	6.5	7.5	52	10(19)	30(58)	9(17)	3(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	7.9	13.0	22	7(32)	9(41)	4(18)	1(5)	0(0)	1(5)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	7.6	10.2	20	7(35)	7(35)	3(15)	3(15)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	9.3	10.6	44	4(9)	28(64)	6(14)	4(9)	2(5)	0(0)	0(0)	0(0)	0(0)	1-10
41.	TR	**15.4**	**14.3**	109	5(5)	43(39)	33(30)	19(17)	6(6)	1(1)	2(2)	0(0)	0(0)	1-10
42.	TW	9.6	8.6	43	3(7)	23(53)	9(21)	8(19)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	**12.2**	**11.8**	11	1(9)	6(55)	2(18)	1(9)	1(9)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	7.7	7.6	3	0(0)	2(67)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
45.	LO:E-UP +TR	**21.9**	**20.4**	11	0(0)	3(27)	3(27)	3(27)	1(9)	0(0)	1(9)	0(0)	0(0)	11-20
46.	LO:BHR +TR	8.3	6.3	6	0(0)	5(83)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
47.	LO:JRK +TR	**18.1**	**20.1**	13	1(8)	5(38)	3(23)	1(8)	2(15)	0(0)	1(8)	0(0)	0(0)	11-20
48.	LO:ORS +TR	**11.8**	**16.3**	9	1(11)	5(56)	1(11)	1(11)	1(11)	0(0)	0(0)	0(0)	0(0)	1-10
49.	LO:CTS +TR	14.9	8.9	8	0(0)	3(38)	2(25)	3(38)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
50.	LO:E-MP +TR	**13.1**	**13.3**	10	1(10)	4(40)	2(20)	2(20)	1(10)	0(0)	0(0)	0(0)	0(0)	11-20
51.	LO:GWB +TR	**17.7**	**18.9**	10	0(0)	5(50)	2(20)	1(10)	1(10)	1(10)	0(0)	0(0)	0(0)	1-10
52.	LO:BD +TR	9.2	6.6	4	0(0)	2(50)	2(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
53.	CY:NW-BAY+TR	11.1	9.8	16	2(13)	6(38)	4(25)	4(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**15.5**	**12.9**	23	0(0)	9(39)	7(30)	5(22)	2(9)	0(0)	0(0)	0(0)	0(0)	11-20
55.	CY:BHR+TR	**15.6**	**12.1**	16	0(0)	6(38)	5(31)	4(25)	1(6)	0(0)	0(0)	0(0)	0(0)	11-20
56.	CY:JRK+TR	7.9	4.0	9	1(11)	6(67)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	**15.5**	**17.4**	9	1(11)	3(33)	3(33)	1(11)	0(0)	1(11)	0(0)	0(0)	0(0)	11-20
58.	CY:CTS+TR	7.8	4.0	4	0(0)	2(50)	2(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	**19.8**	**18.5**	6	0(0)	3(50)	1(17)	0(0)	2(33)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	**14.8**	**11.1**	16	0(0)	6(38)	7(44)	1(6)	2(13)	0(0)	0(0)	0(0)	0(0)	11-20
61.	CY:GWB+TR	8.4	6.7	9	0(0)	6(67)	2(22)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	10.1	8.0	28	1(4)	15(54)	8(29)	4(14)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	**13.8**	**14.3**	15	1(7)	6(40)	5(33)	2(13)	0(0)	1(7)	0(0)	0(0)	0(0)	11-20
64.	CY:NE-ASS+TR	**12.6**	**10.8**	29	4(14)	9(31)	10(34)	5(17)	1(3)	0(0)	0(0)	0(0)	0(0)	11-20
65.	CY:BHR+TW	5.3	4.7	7	1(14)	4(57)	2(29)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	8.3	3.5	5	0(0)	4(80)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	5.7	7.6	10	3(30)	5(50)	1(10)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	**14.8**	**13.5**	45	1(2)	22(49)	11(24)	8(18)	2(4)	0(0)	1(2)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	6.7	9.3	13	3(23)	6(46)	3(23)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
	Total			1381	293(21)	671(49)	253(18)	117(8)	34(2)	7(1)	6(0)	0(0)	0(0)	

TABLE 13

Same as Table 4 but for Sub-Catchment No. 10

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	0.7	-	1	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
2.	CS:NW-BAY	**11.5**	**16.3**	2	1(50)	0(0)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	5.3	5.6	4	1(25)	2(50)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	3.3	5.5	15	7(47)	7(47)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	3.9	4.5	15	6(40)	8(53)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	1.5	2.1	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	13.0	8.5	5	0(0)	3(60)	0(0)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
8.	DP:BD	8.0	11.3	2	1(50)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
9.	DP:JRK	6.5	5.4	9	1(11)	6(67)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	4.7	7.2	14	5(36)	8(57)	0(0)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	5.6	5.7	8	2(25)	5(63)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	1.3	1.4	5	2(40)	3(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	2.0	3.2	12	7(58)	5(42)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
14.	LO:NW-BAY	3.2	6.1	115	60(52)	45(39)	6(5)	3(3)	1(1)	0(0)	0(0)	0(0)	0(0)	No rain
15.	LO:EC-BAY	0.3	0.8	9	8(89)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	2.0	3.8	40	25(63)	13(33)	2(5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	1.5	2.9	8	6(75)	2(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
18.	LO:BHR	3.0	2.6	12	3(25)	9(75)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	5.2	8.9	29	13(45)	10(34)	4(14)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	3.6	5.9	28	13(46)	14(50)	0(0)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	3.5	5.3	33	14(42)	15(45)	4(12)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	3.7	4.9	32	9(28)	20(63)	2(6)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	5.9	2.1	3	0(0)	3(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
24.	LO:GWB	5.3	7.3	23	7(30)	12(52)	3(13)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	5.9	6.5	10	3(30)	4(40)	3(30)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	0.1	0.2	7	7(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	3.0	4.5	67	26(39)	35(52)	6(9)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	1.5	2.0	26	14(54)	12(46)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
29.	CY:E-UP	3.7	10.2	29	16(55)	11(38)	1(3)	0(0)	0(0)	1(3)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	4.2	6.4	50	20(40)	23(46)	5(10)	2(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	6.1	8.5	30	13(43)	10(33)	6(20)	0(0)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	2.6	3.4	20	9(45)	11(55)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	5.4	7.3	11	4(36)	5(45)	2(18)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	1.8	2.2	6	1(17)	5(83)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	9.9	13.5	35	11(31)	14(40)	3(9)	5(14)	1(3)	1(3)	0(0)	0(0)	0(0)	1-10
36.	CY:GWB	6.0	7.2	29	9(31)	15(52)	2(7)	3(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	5.4	7.0	52	17(33)	25(48)	6(12)	4(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	6.4	9.0	22	6(27)	13(59)	1(5)	2(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	4.8	7.3	20	10(50)	8(40)	1(5)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	5.2	6.3	44	11(25)	25(57)	6(14)	2(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
41.	TR	**14.0**	**15.5**	109	18(17)	40(37)	26(24)	15(14)	5(5)	3(3)	2(2)	0(0)	0(0)	1-10
42.	TW	7.7	8.9	43	9(21)	26(60)	4(9)	3(7)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	**11.2**	**15.1**	11	3(27)	5(45)	1(9)	0(0)	2(18)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	2.4	2.1	3	1(33)	2(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
45.	LO:E-UP +TR	**15.1**	**12.0**	11	1(9)	4(36)	2(18)	3(27)	1(9)	0(0)	0(0)	0(0)	0(0)	11-20
46.	LO:BHR +TR	9.9	6.1	6	0(0)	4(67)	1(17)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
47.	LO:JRK +TR	**15.3**	**17.7**	13	2(15)	5(38)	3(23)	1(8)	1(8)	1(8)	0(0)	0(0)	0(0)	1-10
48.	LO:ORS +TR	**10.3**	**12.8**	9	1(11)	5(56)	2(22)	0(0)	1(11)	0(0)	0(0)	0(0)	0(0)	1-10
49.	LO:CTS +TR	5.0	4.9	8	2(25)	5(63)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	6.3	6.2	10	2(20)	6(60)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	**16.8**	**16.8**	10	1(10)	3(30)	3(30)	2(20)	0(0)	1(10)	0(0)	0(0)	0(0)	11-20
52.	LO:BD +TR	**15.5**	**17.1**	4	1(25)	1(25)	0(0)	2(50)	0(0)	0(0)	0(0)	0(0)	0(0)	21-35
53.	CY:NW-BAY+TR	**10.3**	**10.4**	16	2(13)	10(63)	0(0)	4(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	9.6	9.6	23	3(13)	11(48)	6(26)	2(9)	1(4)	0(0)	0(0)	0(0)	0(0)	1-10
55.	CY:BHR+TR	**15.0**	**12.1**	16	1(6)	6(38)	5(31)	3(19)	1(6)	0(0)	0(0)	0(0)	0(0)	11-20
56.	CY:JRK+TR	5.6	4.8	9	3(33)	5(56)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	4.3	2.3	9	1(11)	8(89)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
58.	CY:CTS+TR	6.4	6.3	4	0(0)	3(75)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	6.1	6.3	6	2(33)	2(33)	2(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	9.5	7.7	16	2(13)	7(44)	6(38)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	6.6	5.9	9	2(22)	5(56)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	9.0	10.4	28	3(11)	16(57)	6(21)	2(7)	1(4)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	6.2	5.3	15	3(20)	9(60)	3(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	**12.0**	**10.7**	29	6(21)	8(28)	11(38)	3(10)	1(3)	0(0)	0(0)	0(0)	0(0)	11-20
65.	CY:BHR+TW	4.7	7.4	7	3(43)	2(29)	2(29)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	9.7	14.4	5	2(40)	2(40)	0(0)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	4.6	5.9	10	4(40)	5(50)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	**11.5**	**12.4**	45	5(11)	25(56)	6(13)	6(13)	3(7)	0(0)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	4.7	9.4	13	5(38)	6(46)	1(8)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
	Total			1381	457(33)	645(47)	168(12)	81(6)	21(2)	7(1)	2(0)	0(0)	0(0)	

single occasion (100%), (*ii*) Depression over Jharkhand, Orissa, Chhattisgarh and East MP respectively for 8(89%), 11 (79%), 5 (63%) and 3 (60%) occasions, (*iii*) Low over East UP, Bihar, Orissa and East MP respectively for 5 (63%), 8 (67%), 18 (64%) and 21 (66%) occasions, (*iv*) CYCIR over Orissa, East Madhya Pradesh, GWB, Bangladesh, West Assam and Central Assam respectively for 17 (85%), 6 (100%), 19 (66%), 35 (67%), 16 (73%) and 13 (65%) occasions, (*v*) Trough passing through NER in association with Low over Orissa and East MP respectively for 6 (67%) and 8 (80%) occasions, (*vi*) Trough passing through NER in association with CYCIR over NW Bay, Jharkhand, Chhattisgarh, East MP and GWB respectively for 12 (75%), 6 (67%), 3 (75%), 4 (67%), and 6 (67%) occasions, (*vii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over Bihar for 6 (86%) occasions and (*viii*) Trough passing through NER in association with Trough in Westerlies between 85° E - 89° E north of 20° N for 27 (60%).

(d) There were five most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Depression over GWB and Bangladesh respectively for 3 (60%) and 1 (50%) occasions, (*ii*) Trough passing through NER in association with Low over WC Bay and Bihar respectively for 2 (67%) and 4 (67%) occasions and (*iii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over GWB for 2 (40%) occasions.

(e) There were three most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Cyclonic Storm over WC Bay for a single occasion (25%), (*ii*) Depression over Chhattisgarh for two occasions (25%) and (*iii*) Trough passing through NER in association with Low over Chhattisgarh for 3(38%) occasions.

(f) There were three most important systems favourable (25% or more) producing AAP in the range 36-50 mm or more. Those were (*i*) Depression over Bangladesh for single occasion (50%) and (*ii*) Trough passing through NER in association with Low over Bangladesh and Jharkhand for 1(25%) and 4(31%) occasions respectively.

5.9. *Sub-Catchment No. 9*

The detailed summary is shown in Table 12. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 293 days (21%), (*ii*) 1-10 mm for 671 days (49%), (*iii*) 11-20 mm for 253 days (18%), (*iv*) remaining days were in the range of 21-35 mm and more, (*v*) 21-35 mm for 117 days (8%) and (*vi*) remaining 47 days (3%) were in the range 36-50 mm and more.

(b) Three most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Depression over East-Central Bay for twice (100%), (*ii*) Low over East-Central Bay for 6 (67%) occasions and (*iii*) CYCIR over NE Bay for 7 (100%) occasions.

(c) Seventeen (17) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Cyclonic Storm over NE Bay and WC Bay respectively for 1 (100%) and 3 (75%) occasions, (*ii*) Depression over Jharkhand, Chhattisgarh and East MP respectively for 8 (89%), 5 (63%) and 4 (80%) occasions, (*iii*) Low over Orissa, East MP and Bangladesh respectively for 18 (64%), 20 (63%) and 7 (70%) occasions, (*iv*) CYCIR over Orissa, Chhattisgarh, East MP and NE Assam respectively for 12 (60%), 8 (73%), 6 (100%) and 28 (64%) occasions, (*v*) Trough passing through NER in association with Low over Bihar and WC Bay respectively for 5 (83%) and 2 (67%) occasions, (*vi*) Trough passing through NER in association with CYCIR over Jharkhand and GWB respectively for 6(67%) occasions each and (*vii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over GWB for 4 (80%) occasions.

(d) There were five most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Cyclonic Storm over NW Bay for a single occasion (50%), (*ii*) Depression over GWB for 3(60%) occasions, (*iii*) Trough passing through NER in association with Low over Bangladesh for 2(50%) occasions and (*iv*) Trough passing through NER in association with CYCIR over Chhattisgarh and SHWB respectively for 2(50%) and 7(44%) occasions.

(e) There were five most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Depression over Bangladesh for single occasion (50%), (*ii*) Trough passing through NER in association with Low over East UP and Chhattisgarh respectively for 3 (27%) and 3 (38%) occasions and (*iii*) Trough passing through NER in association with CYCIR over North West Bay and Bihar respectively for 4 (25%) occasions each.

(f) There was one most important system favourable (25% or more) producing AAP in the range 36-50 mm or more. This was Trough passing through NER in association with CYCIR over East MP for 2(33%) occasions.

TABLE 14

Same as Table 4 but for Sub-Catchment No. 11

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	18.3	-	1	0(0)	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
2.	CS:NW-BAY	13.2	1.7	2	0(0)	0(0)	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
3.	CS:WC-BAY	5.1	1.5	4	0(0)	4(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	3.0	5.7	15	9(60)	4(27)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
5.	DP:WC-BAY	3.3	4.8	15	7(47)	6(40)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.0	0.0	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	6.2	4.0	5	0(0)	3(60)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
8.	DP:BD	11.5	1.3	2	0(0)	0(0)	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
9.	DP:JRK	4.3	3.9	9	0(0)	8(89)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	2.8	3.2	14	3(21)	10(71)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	6.5	3.9	8	0(0)	7(88)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	1.4	1.9	5	2(40)	3(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	2.4	3.1	12	5(42)	7(58)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
14.	LO:NW-BAY	3.5	6.0	115	38(33)	68(59)	5(4)	3(3)	1(1)	0(0)	0(0)	0(0)	0(0)	1-10
15.	LO:EC-BAY	0.3	0.6	9	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	2.1	3.8	40	22(55)	16(40)	2(5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	1.6	1.8	8	3(38)	5(63)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	2.8	3.0	12	4(33)	8(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	5.9	10.7	29	9(31)	14(48)	4(14)	1(3)	0(0)	1(3)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	2.9	3.1	28	10(36)	18(64)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	4.9	8.6	33	11(33)	15(45)	5(15)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	2.5	3.6	32	10(31)	21(66)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	9.1	8.8	3	0(0)	2(67)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
24.	LO:GWB	5.5	6.8	23	7(30)	13(57)	2(9)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	3.3	6.2	10	3(30)	6(60)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	1.5	2.2	7	3(43)	4(57)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
27.	CY:NW-BAY	3.5	4.2	67	26(39)	37(55)	3(4)	1(1)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	3.0	6.7	26	7(27)	17(65)	1(4)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
29.	CY:E-UP	2.3	2.9	29	12(41)	16(55)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	3.7	5.0	50	16(32)	27(54)	6(12)	1(2)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	2.6	4.3	30	14(47)	14(47)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	3.0	3.1	20	4(20)	15(75)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	9.5	21.2	11	4(36)	4(36)	2(18)	0(0)	0(0)	0(0)	1(9)	0(0)	0(0)	1-10
34.	CY:E-MP	2.9	2.3	6	1(17)	5(83)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	5.0	8.1	35	7(20)	23(66)	3(9)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
36.	CY:GWB	3.8	3.5	29	3(10)	23(79)	3(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	5.7	11.8	52	8(15)	40(77)	1(2)	2(4)	0(0)	0(0)	1(2)	0(0)	0(0)	1-10
38.	CY:W-ASS	3.6	4.8	22	8(36)	12(55)	2(9)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	6.5	7.9	20	2(10)	14(70)	3(15)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	6.5	6.0	44	9(20)	23(52)	11(25)	1(2)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
41.	TR	6.8	6.8	109	11(10)	75(69)	19(17)	3(3)	1(1)	0(0)	0(0)	0(0)	0(0)	1-10
42.	TW	5.1	6.7	43	10(23)	27(63)	4(9)	2(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	6.5	4.2	11	1(9)	8(73)	2(18)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	13.8	9.8	3	0(0)	1(33)	1(33)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
45.	LO:E-UP +TR	**10.2**	**11.0**	11	1(9)	6(55)	2(18)	2(18)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
46.	LO:BHR +TR	4.8	2.6	6	1(17)	5(83)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
47.	LO:JRK +TR	6.9	8.4	13	3(23)	7(54)	2(15)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
48.	LO:ORS +TR	**24.5**	**24.0**	9	0(0)	3(33)	2(22)	2(22)	1(11)	0(0)	1(11)	0(0)	0(0)	11-20
49.	LO:CTS +TR	3.4	4.0	8	1(13)	6(75)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	2.8	3.5	10	3(30)	6(60)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	9.3	10.2	10	1(10)	6(60)	2(20)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
52.	LO:BD +TR	9.2	6.9	4	0(0)	2(50)	2(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
53.	CY:NW-BAY+TR	5.2	6.2	16	1(6)	14(88)	0(0)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	6.5	5.0	23	2(9)	18(78)	2(9)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
55.	CY:BHR+TR	6.6	5.0	16	0(0)	13(81)	2(13)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
56.	CY:JRK+TR	4.2	4.7	9	1(11)	6(67)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	6.8	6.6	9	1(11)	6(67)	1(11)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
58.	CY:CTS+TR	5.4	2.5	4	0(0)	4(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	4.4	2.6	6	0(0)	6(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	3.2	3.1	16	3(19)	13(81)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	6.3	7.4	9	0(0)	7(78)	1(11)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	6.5	6.6	28	4(14)	20(71)	1(4)	3(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	3.3	2.4	15	1(7)	14(93)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	5.1	5.9	29	4(14)	20(69)	4(14)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
65.	CY:BHR+TW	1.1	1.9	7	4(57)	3(43)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
66.	CY:GWB+TW	5.8	5.2	5	1(20)	3(60)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	3.1	3.1	10	2(20)	8(80)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	6.0	6.8	45	5(11)	32(71)	6(13)	2(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	6.1	4.4	13	2(15)	9(69)	2(15)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
	Total			1381	339(25)	862(62)	134(10)	37(3)	5(0)	1(0)	3(0)	0(0)	0(0)	

5.10. *Sub-Catchment No. 10*

The detailed summary is shown in Table 13. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 457 days (33%), (*ii*) 1-10 mm for 645 days (47%), (*iii*) 11-20 mm for 168 days (12%), (*iv*) remaining were in the range of 21-35 mm and more, (*v*) 21-35 mm for 81 days (6%) and (*vi*) remaining 30 days (2%) were in the range 36-50 mm and more.

(b) Three most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Low over East-Central Bay, WC Bay and East UP respectively for 8 (89%), 25 (63%) and 6 (75%) occasions and (*ii*) CYCIR over NE Bay for 7 (100%) occasions.

(c) Eighteen (18) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Cyclonic Storm over NE Bay for a single occasion (100%), (*ii*) Depression over East Madhya Pradesh, Chhattisgarh, Jharkhand and GWB respectively for 3 (60%), 5 (63%), 6 (67%) and 3 (60%) occasions, (*iii*) Low over Bihar, East MP and SHWB respectively for 9 (75%), 20 (63%) and 3 (100%) occasions, (*iv*) CYCIR over East MP for 5(83%) occasions, (*v*) Trough in W'lies between 85° E - 89° E north of 20° N for 26(60%), (*vi*) Trough passing through NER in association with Low over East Madhya Pradesh, Chhattisgarh, Bihar and WC Bay respectively for 6 (60%), 5 (63%), 4 (67%) and 2 (67%) occasions and (*vii*) Trough passing through NER in association with CYCIR over North West Bay, Orissa, Chhattisgarh and West Assam respectively for 10 (63%), 8 (89%), 3 (75%) and 9 (60%) occasions respectively.

(d) Depression over Bangladesh was the most important systems favourable (40% or more) for producing AAP in the range 11-20 mm with frequency 1 (50%) occasion.

(e) There were five most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Cyclonic Storm over NW Bay for a single occasion (50%), (*ii*) Depression over GWB for two occasions (40%), (*iii*) Trough passing through NER in association with Low over East UP and Bangladesh for 3 (27%) and 2 (50%) occasions respectively and (*iv*) Trough passing through NER in association with CYCIR over North West Bay for 4 (25%) occasions.

5.11. *Sub-Catchment No. 11*

The detailed summary is shown in Table 14. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 339 days (25%), (*ii*) 1-10 mm for 862 days (62%), (*iii*) 11-20 mm for 134 days (10%), (*iv*) remaining days were in the range of 21- 35 mm and more, (*v*) 21-35 mm for 37 days (3%) and (*vi*) remaining 9 days (1%) were in the range 36-50 mm and more.

(b) Three most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Depression over NW Bay and East-Central Bay respectively for 9 (60%) and 2 (100%) occasions and (*ii*) Low over East-Central Bay for 7(78%) occasions.

(c) Forty two (42) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Cyclonic Storm over WC Bay for 4 (100%) occasions, (*ii*) Depression over GWB, Jharkhand, Orissa, Chhattisgarh and East MP respectively for 3 (60%), 8 (89%), 10 (71%), 7 (88%) and 3 (60%) occasions, (*iii*) Low over East UP, Bihar, Orissa, East Madhya Pradesh, SHWB and Bangladesh respectively for 5 (63%), 8 (67%), 18 (64%), 21 (66%), 2 (67%) and 6 (60%) occasions, (*iv*) CYCIR over WC Bay, Orissa, East Madhya Pradesh, SHWB, GWB, Bangladesh, and Central Assam respectively for 17 (65%), 15 (75%), 5 (83%), 23 (66%), 23 (79%), 40 (77%) and 14 (70%) occasions, (*v*) Trough passing through NER for 75 (69%) occasions, (*vi*) Trough in Westerlies between 85° E - 89° E north of 20° N for 27(63%) occasions, (*vii*) Trough passing through NER in association with Low over North-West Bay, Bihar, Chhattisgarh, East MP and GWB respectively for 8(73%),5(83%), 6(75%), 6(60%) and 6(60%) occasions, (*viii*) Trough passing through NER in association with CYCIR over NW Bay, East UP, Bihar, Jharkhand, Orissa, Chhattisgarh, East Madhya Pradesh, SHWB, GWB, Bangladesh, West Assam and NE Assam respectively for 14 (88%), 18 (78%), 13 (81%), 6 (67%), 6 (67%), 4 (100%), 6 (100%), 13 (81%), 7 (78%), 20 (71%), 14 (93%) and 20 (69%) occasions, (*ix*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over GWB and NE Assam respectively for 3 (60%) and 8 (80%) occasions, (*x*) Trough passing through NER in association with Trough in Westerlies between 85° E - 89° E north of 20° N for 32 (71%) and (*xi*) CYCIR over NW Bay in combination with another CYCIR over NE Assam for 9 (69%) cases.

(d) There were five most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Cyclonic Storm over NE Bay and NW Bay respectively for 1 (100%) and 2 (100%) occasions, (*ii*) Depression over GWB and Bangladesh for 2 (40%) and 2 (100%) occasions respectively and (*iii*) Trough

TABLE 15

Same as Table 4 but for Sub-Catchment No.12

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	7.4	-	1	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
2.	CS:NW-BAY	**23.8**	**21.6**	2	0(0)	1(50)	0(0)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	1-10
3.	CS:WC-BAY	4.0	3.7	4	0(0)	4(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	5.4	5.8	15	4(27)	8(53)	3(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	6.3	6.2	15	4(27)	8(53)	3(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	2.3	3.0	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	12.2	7.8	5	0(0)	3(60)	1(20)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
8.	DP:BD	13.5	0.4	2	0(0)	0(0)	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
9.	DP:JRK	4.4	3.3	9	0(0)	9(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	6.0	5.1	14	2(14)	9(64)	3(21)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	9.4	9.8	8	0(0)	5(63)	2(25)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	2.7	3.3	5	1(20)	4(80)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	4.9	6.4	12	4(33)	6(50)	2(17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
14.	LO:NW-BAY	4.0	4.7	115	24(21)	81(70)	8(7)	2(2)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
15.	LO:EC-BAY	0.1	0.2	9	8(89)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	2.1	2.7	40	15(38)	25(63)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
17.	LO:E-UP	3.6	3.6	8	3(38)	5(63)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	7.0	6.1	12	1(8)	8(67)	3(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	7.7	8.4	29	3(10)	18(62)	6(21)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	6.9	6.2	28	3(11)	20(71)	5(18)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	6.0	6.1	33	1(3)	28(85)	3(9)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	5.7	5.2	32	3(9)	23(72)	6(19)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	**10.9**	**15.8**	3	0(0)	2(67)	0(0)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
24.	LO:GWB	8.3	8.1	23	4(17)	10(43)	7(30)	2(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	7.2	5.7	10	0(0)	5(50)	5(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	0.9	1.2	7	4(57)	3(43)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	5.3	6.7	67	16(24)	39(58)	11(16)	0(0)	1(1)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	2.6	2.9	26	9(35)	17(65)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
29.	CY:E-UP	3.6	5.2	29	8(28)	19(66)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	6.3	7.0	50	9(18)	33(66)	6(12)	2(4)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	7.3	8.5	30	7(23)	16(53)	4(13)	3(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	4.2	5.4	20	1(5)	17(85)	1(5)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	6.6	6.0	11	2(18)	7(64)	2(18)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	6.5	2.7	6	0(0)	6(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	8.4	10.7	35	6(17)	18(51)	6(17)	4(11)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
36.	CY:GWB	7.0	6.7	29	2(7)	22(76)	3(10)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	6.2	7.3	52	7(13)	37(71)	5(10)	3(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	5.7	6.0	22	5(23)	13(59)	3(14)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
39.	CY:C-ASS	6.0	7.6	20	4(20)	12(60)	3(15)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	5.4	4.6	44	5(11)	33(75)	6(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
41.	TR	10.2	8.1	109	4(4)	57(52)	35(32)	12(11)	1(1)	0(0)	0(0)	0(0)	0(0)	1-10
42.	TW	7.2	6.7	43	3(7)	30(70)	7(16)	3(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	11.1	10.1	11	1(9)	6(55)	1(9)	3(27)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	8.5	6.2	3	0(0)	1(33)	2(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
45.	LO:E-UP +TR	13.3	13.1	11	1(9)	5(45)	3(27)	1(9)	1(9)	0(0)	0(0)	0(0)	0(0)	1-10
46.	LO:BHR +TR	12.9	3.8	6	0(0)	2(33)	4(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
47.	LO:JRK +TR	**15.3**	**22.5**	13	0(0)	6(46)	4(31)	2(15)	0(0)	0(0)	0(0)	1(8)	0(0)	11-20
48.	LO:ORS +TR	**15.9**	**11.7**	9	0(0)	3(33)	2(22)	4(44)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
49.	LO:CTS +TR	5.3	4.6	8	0(0)	6(75)	2(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	6.7	5.7	10	1(10)	7(70)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	**13.2**	**10.5**	10	0(0)	6(60)	0(0)	4(40)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
52.	LO:BD +TR	**15.2**	**15.7**	4	0(0)	2(50)	0(0)	2(50)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
53.	CY:NW-BAY+TR	8.9	7.8	16	0(0)	11(69)	3(19)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	9.2	7.9	23	0(0)	17(74)	4(17)	2(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
55.	CY:BHR+TR	17.9	15.7	16	0(0)	6(38)	4(25)	5(31)	0(0)	0(0)	0(0)	1(6)	0(0)	11-20
56.	CY:JRK+TR	8.9	4.9	9	0(0)	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	7.1	3.4	9	0(0)	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
58.	CY:CTS+TR	9.6	6.6	4	0(0)	2(50)	2(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	11.1	5.5	6	0(0)	2(33)	4(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
60.	CY:SHWB+TR	11.7	9.3	16	0(0)	9(56)	4(25)	2(13)	1(6)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	**10.9**	**11.6**	9	0(0)	6(67)	2(22)	0(0)	1(11)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	9.7	8.8	28	0(0)	18(64)	7(25)	3(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	10.3	7.2	15	0(0)	8(53)	6(40)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	9.4	7.6	29	1(3)	18(62)	7(24)	3(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
65.	CY:BHR+TW	5.7	5.8	7	0(0)	6(86)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	14.5	9.2	5	0(0)	2(40)	1(20)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
67.	CY:NE-ASS+TW	5.0	4.6	10	2(20)	6(60)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	**10.0**	**10.2**	45	3(7)	27(60)	11(24)	3(7)	0(0)	1(2)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	5.0	4.8	13	2(15)	10(77)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
	Total			1381	184(13)	870(63)	235(17)	81(6)	8(1)	1(0)	1(0)	1(0)	0(0)	

TABLE 16

Same as Table 4 but for Sub-Catchment No. 13

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	30.7	-	1	0(0)	0(0)	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	21-35
2.	CS:NW-BAY	4.3	6.0	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	9.8	12.0	4	1(25)	1(25)	1(25)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	2.2	3.9	15	8(53)	5(33)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
5.	DP:WC-BAY	3.7	4.2	15	6(40)	8(53)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.0	0.0	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	11.0	6.0	5	0(0)	2(40)	3(60)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
8.	DP:BD	3.0	1.7	2	0(0)	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
9.	DP:JRK	9.8	8.8	9	0(0)	5(56)	2(22)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	3.0	3.1	14	4(29)	10(71)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	1.5	1.9	8	3(38)	5(63)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	0.2	0.5	5	4(80)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
13.	LO:NE-BAY	0.7	1.2	12	8(67)	4(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
14.	LO:NW-BAY	3.0	8.1	115	58(50)	50(43)	5(4)	1(1)	0(0)	0(0)	1(1)	0(0)	0(0)	No rain
15.	LO:EC-BAY	0.2	0.5	9	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	2.0	3.8	40	24(60)	13(33)	3(8)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	2.4	4.5	8	5(63)	2(25)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
18.	LO:BHR	1.9	2.0	12	4(33)	8(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	5.4	9.0	29	10(34)	15(52)	2(7)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	2.2	2.9	28	14(50)	14(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	3.0	4.9	33	15(45)	15(45)	3(9)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	5.0	8.9	32	10(31)	18(56)	2(6)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	3.2	2.5	3	1(33)	2(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
24.	LO:GWB	6.7	10.5	23	10(43)	7(30)	4(17)	1(4)	1(4)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	5.9	8.4	10	4(40)	3(30)	2(20)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	0.0	0.1	7	7(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	2.2	4.2	67	34(51)	29(43)	3(4)	1(1)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	2.0	2.4	26	8(31)	18(69)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
29.	CY:E-UP	3.0	5.6	29	17(59)	9(31)	2(7)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
30.	CY:BHR	5.7	11.5	50	21(42)	20(40)	6(12)	1(2)	1(2)	1(2)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	3.8	7.4	30	13(43)	14(47)	2(7)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	2.9	5.4	20	10(50)	8(40)	2(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
33.	CY:CTS	8.2	21.1	11	6(55)	4(36)	0(0)	0(0)	0(0)	0(0)	1(9)	0(0)	0(0)	1-10
34.	CY:E-MP	3.9	6.2	6	4(67)	1(17)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	**11.1**	**18.8**	35	12(34)	13(37)	2(6)	4(11)	3(9)	0(0)	0(0)	1(3)	0(0)	1-10
36.	CY:GWB	5.2	10.1	29	12(41)	14(48)	0(0)	2(7)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	5.4	8.1	52	16(31)	26(50)	7(13)	3(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	8.4	20.0	22	8(36)	9(41)	2(9)	2(9)	0(0)	0(0)	0(0)	1(5)	0(0)	1-10
39.	CY:C-ASS	6.4	16.6	20	5(25)	13(65)	1(5)	0(0)	0(0)	0(0)	1(5)	0(0)	0(0)	1-10
40.	CY:NE-ASS	5.7	9.8	44	16(36)	19(43)	6(14)	1(2)	2(5)	0(0)	0(0)	0(0)	0(0)	1-10
41.	TR	**19.0**	**31.6**	109	13(12)	47(43)	26(24)	6(6)	7(6)	1(1)	2(2)	3(3)	4(4)	1-10
42.	TW	6.4	10.3	43	8(19)	27(63)	5(12)	1(2)	2(5)	0(0)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	7.5	12.1	11	4(36)	4(36)	1(9)	1(9)	1(9)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	5.8	5.8	3	1(33)	1(33)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
45.	LO:E-UP +TR	**44.8**	**47.7**	11	1(9)	1(9)	4(36)	1(9)	0(0)	0(0)	1(9)	1(9)	2(18)	11-20
46.	LO:BHR +TR	13.1	7.7	6	1(17)	0(0)	4(67)	1(17)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
47.	LO:JRK +TR	**12.6**	**14.7**	13	4(31)	3(23)	2(15)	2(15)	2(15)	0(0)	0(0)	0(0)	0(0)	1-10
48.	LO:ORS +TR	**18.3**	**26.7**	9	2(22)	4(44)	0(0)	1(11)	1(11)	0(0)	1(11)	0(0)	0(0)	1-10
49.	LO:CTS +TR	3.7	6.8	8	3(38)	4(50)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	4.1	4.8	10	2(20)	7(70)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	**13.3**	**18.3**	10	2(20)	3(30)	4(40)	0(0)	0(0)	1(10)	0(0)	0(0)	0(0)	11-20
52.	LO:BD +TR	**31.3**	**40.4**	4	1(25)	1(25)	0(0)	1(25)	0(0)	0(0)	0(0)	1(25)	0(0)	1-10
53.	CY:NW-BAY+TR	5.6	4.5	16	2(13)	13(81)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	13.1	14.6	23	3(13)	10(43)	5(22)	2(9)	3(13)	0(0)	0(0)	0(0)	0(0)	1-10
55.	CY:BHR+TR	**26.4**	**43.4**	16	1(6)	8(50)	4(25)	0(0)	0(0)	1(6)	0(0)	0(0)	2(13)	1-10
56.	CY:JRK+TR	4.3	3.7	9	1(11)	7(78)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	9.5	19.3	9	0(0)	8(89)	0(0)	0(0)	0(0)	1(11)	0(0)	0(0)	0(0)	1-10
58.	CY:CTS+TR	5.9	6.7	4	0(0)	3(75)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	7.3	6.3	6	0(0)	4(67)	2(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	7.9	6.9	16	0(0)	11(69)	4(25)	1(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
61.	CY:GWB+TR	8.8	9.5	9	1(11)	4(44)	3(33)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	5.7	6.5	28	4(14)	19(68)	3(11)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	**11.9**	**15.4**	15	1(7)	9(60)	3(20)	0(0)	2(13)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	**13.6**	**16.4**	29	2(7)	17(59)	3(10)	4(14)	2(7)	0(0)	1(3)	0(0)	0(0)	1-10
65.	CY:BHR+TW	2.9	5.2	7	3(43)	3(43)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	9.2	7.3	5	0(0)	3(60)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	2.6	4.5	10	4(40)	5(50)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	**12.3**	**12.4**	45	1(2)	26(58)	11(24)	3(7)	3(7)	1(2)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	3.1	8.2	13	7(54)	5(38)	0(0)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
	Total			1381	459(33)	647(47)	159(12)	53(4)	33(2)	6(0)	8(1)	7(1)	8(1)	

passing through NER in association with Low over Bangladesh for 2 (50%) occasions.

(e) There was a single most important systems favourable (25% or more) producing AAP in the range 21-35 mm and was Trough passing through NER in association with CYCIR over WC Bay for a single occasion (33%).

5.12. *Sub-Catchment No. 12*

The detailed summary is shown in Table 15. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 184 days (13%), (*ii*) 1-10 mm for 870 days (63%), (*iii*) 11-20 mm for 235 days (17%), (*iv*) remaining days were in the range of 21-35 mm and more, (*v*) 21-35 mm for 81 days (6%) and (*vi*) remaining 11 days (1%) were in the range 36-50 mm and more.

(b) There was a single most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" and was Low over East-Central Bay for 8(89%) occasions.

(c) Forty one (41) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Cyclonic Storm over NE Bay and WC Bay respectively for 1 (100%) and 4 (100%) occasions, (*ii*) Depression over GWB, Jharkhand, Orissa, Chhattisgarh and East MP respectively for 3 (60%), 9 (90%), 9 (64%), 5 (63%), and 4 (80%) occasions, (*iii*) Low over North West Bay, WC Bay, East UP, Bihar, Jharkhand, Orissa, Chhattisgarh, East MP and SHWB respectively for 81 (70%), 25 (63%), 5 (63%), 8 (67%), 18 (62%), 20 (71%), 28 (85%), 23 (72%) and 2 (67%) occasions, (*iv*) CYCIR over WC Bay, East UP, Bihar, Orissa, Chhattisgarh, East Madhya Pradesh, GWB, Bangladesh, Central Assam and NE Assam respectively for 17 (65%), 19 (66%), 33 (66%), 17 (85%), 7 (64%), 6 (100%), 22 (76%), 37 (71%), 12 (60%) and 33 (75%) occasions, (*v*) Trough in Westerlies between 85° E - 89° E north of 20° N for 30 (70%) occasions, (*vi*) Trough passing through NER in association with Low over Chhattisgarh, East MP and GWB respectively for 6(75%), 7 (70%) and 6 (60%) occasions, (*vii*) Trough passing through NER in association with CYCIR over North West Bay, East UP, Jharkhand, Orissa, GWB, Bangladesh and NE Assam respectively for 11 (69%), 17 (74%), 7 (78%), 7 (78%), 6 (67%), 18 (64%) and 18 (62%) occasions, (*viii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over Bihar and NE Assam respectively for 6 (86%) and 6 (60%) occasions, (*ix*) Trough passing through NER in association with Trough in Westerlies between 85° E - 89° E north of 20° N for 27 (60%) and (*x*) CYCIR over NW Bay in combination with another CYCIR over NE Assam for 10 (77%) cases.

(d) There were seven most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Depression over Bangladesh for 2(100%) occasions, (*ii*) Low over Bangladesh for 5(50%) occasions, (*iii*) Trough passing through NER in association with Low over WC Bay and Bihar respectively for 2 (67%) and 4 (67%) occasions and (*iv*) Trough passing through NER in association with CYCIR over Chhattisgarh, East MP and West Assam respectively for 2 (50%), 4 (67%) and 6 (40%) occasions.

(e) There were seven most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Low over SHWB for a single occasion (33%), (*ii*) Trough passing through NER in association with Low over NW Bay, Orissa, GWB and Bangladesh respectively for 3 (27%), 4 (44%), 4 (40%) and 2 (50%) occasions, (*iii*) Trough passing through NER in association with CYCIR over Bihar for 5 (31%) occasions and (*iv*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over GWB respectively for 2 (40%) occasions.

(f) There was one most important system favourable (25% or more) producing AAP in the range 36-50 mm or more. This was Cyclonic Storm over NW Bay for 1 (50%) occasions.

5.13. *Sub-Catchment No. 13*

The detailed summary is shown in Table 16. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 459 days (33%), (*ii*) 1-10 mm for 647 days (47%), (*iii*) 11-20 mm for 159 days (11%), (*iv*) remaining days were in the range of 21-35 mm and more, (*v*) 21-35 mm for 53 days (4%) and (*vi*) remaining 62 days (4%) were in the range 36-50 mm and more.

(b) Eight (8) most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Depression over East-Central Bay and East MP respectively for 2 (100%) and 4 (80%) occasions, (*ii*) Low over NE Bay, East-Central Bay, West-Central Bay and East UP for 8 (67%), 7 (78%), 24 (60%) and 5 (63%) occasions respectively and (*iii*) CYCIR over NE Bay and East MP respectively for 7 (100%) and 4 (67%) occasions.

(c) Eighteen (18) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Depression over Bangladesh, Orissa and Chhattisgarh respectively for 2 (100%), 10 (71%) and 5 (63%) occasions, (*ii*) Low over Bihar and SHWB respectively for 8 (67%), and 2 (67%) occasions, (*iii*) CYCIR over West-Central Bay and Central Assam respectively for 18 (69%) and 13 (65%) occasions, (*iv*) Trough in Westerlies between 85° E - 89° E north of 20° N for 27 (63%) occasions, (*v*) Trough passing through NER in association with Low over East MP for 7 (70%) occasions, (*vi*) Trough passing through NER in association with CYCIR over NW Bay, Jharkhand, Orissa, Chhattisgarh, East Madhya Pradesh, SHWB, Bangladesh and West Assam respectively for 13 (81%), 7 (78%), 8 (89%), 3 (75%), 4 (67%), 11 (69%), 19 (68%) and 9 (60%) occasions and (*vii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over GWB for 3 (60%) occasions.

(d) There were four most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Depression over GWB for 3 (60%) occasions, (*ii*) Trough passing through NER in association with Low over Bihar and GWB respectively for 4 (67%) and 4 (40%) occasions and (*iii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over GWB for 2 (40%) occasions.

(e) There were five most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Cyclonic Storm over NE Bay and West-Central Bay for 1 (100%) and 1 (25%) occasions respectively and (*ii*) Trough passing through NER in association with Low over Bangladesh for a single occasion (25%).

(f) There were two most important systems favourable (25% or more) producing AAP in the range 36-50 mm or more. Those were (*i*) Trough passing through NER in association with Low over East UP and Bangladesh for 4 (36%) and 1 (25%) occasions respectively.

5.14. *Sub-Catchment No. 14*

The detailed summary is shown in Table 17. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 267 days (19%), (*ii*) 1-10 mm for 714 days (52%), (*iii*) 11-20 mm for 220 days (16%) and (*iv*) remaining days were in the range of 21- 35 mm and more, (*iv*) 21-35 mm for 109 days (8%) and (*v*) remaining 71 days (5%) were in the range 36-50 mm and more.

(b) Three most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Cyclonic Storm over NE Bay for a single occasion (100%), (*ii*)Depression over East MP for 3(60%) and (*iii*) Low over East-Central Bay for 8(89%) occasions.

(c) Twenty one (21) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Cyclonic Storm over WC Bay respectively for 3(75%) occasions, (*ii*) Depression over Bangladesh and Chhattisgarh respectively for 2 (100%) and 5 (63%) occasions, (*iii*) Low over Bihar, Orissa and Chhattisgarh respectively for 8 (67%), 17 (61%) and 24 (73%) occasions, (*iv*) CYCIR over WC Bay, Jharkhand, Orissa, East Madhya Pradesh, Bangladesh, Central Assam and NE Assam respectively for 17(65%), 18 (60%), 14 (70%), 4 (67%), 38 (73%), 13 (65%) and 29 (66%) occasions, (*v*) Trough passing through NER in association with Low over WC Bay, Chhattisgarh and East MP respectively for 3 (100%) 5 (63%) and 6 (60%) occasions, (*vi*) Trough passing through NER in association with CYCIR over northwest Bay, Jharkhand and Bangladesh respectively for 10 (63%), 7 (78%) and 19 (68%) occasions each and (*vii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over GWB and NE Assam for 3 (60%) and 7 (70%) occasions respectively.

(d) There were seven most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Depression over WC Bay and Jharkhand for 6 (40%) and 4 (44%) occasions respectively, (*ii*) Low over SHWB and Bangladesh respectively for 2 (67%) and 5 (50%) occasions, (*iii*) Trough passing through NER in association with Low over Bihar for 4(67%) occasions and (*iv*) Trough passing through NER in association with CYCIR over SHWB and West Assam respectively for 8 (50%) and 6 (40%) occasions.

(e) There were five most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Cyclonic Storm over North West Bay respectively for a single occasions (50%), (*ii*) Depression over GWB for 3(60%) occasions, (*iii*) Trough passing through NER in association with Low over East UP for 3(27%) occasions and (*iv*) Trough passing through NER in association with CYCIR over East MPand GWB respectively for 2 (33%) and 3 (33%) occasions.

(f) There were three most important systems favourable (25% or more) producing AAP in the range 36-50 mm or more. Those were (*i*) Trough passing through NER in association with Low over Bangladesh for 3 (75%) occasions and (*ii*) Trough passing through NER in association with CYCIR over Bihar and Chhattisgarh for 6 (37%) and 1 (25%) occasions respectively.

TABLE 17

Same as Table 4 but for Sub-Catchment No. 14

S. No.	System	Mean	S.D.	Freq.	AAP(mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	0.0	-	1	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
2.	CS:NW-BAY	**15.6**	**22.0**	2	1(50)	0(0)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	9.5	5.4	4	0(0)	3(75)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	6.2	6.7	15	6(40)	4(27)	5(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	7.7	7.0	15	3(20)	6(40)	6(40)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	1.9	2.3	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	**22.6**	**15.0**	5	0(0)	2(40)	0(0)	3(60)	0(0)	0(0)	0(0)	0(0)	0(0)	21-35
8.	DP:BD	4.2	0.6	2	0(0)	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
9.	DP:JRK	9.1	6.8	9	0(0)	5(56)	4(44)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	6.6	5.4	14	2(14)	8(57)	4(29)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	4.4	5.3	8	2(25)	5(63)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	1.7	2.4	5	3(60)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
13.	LO:NE-BAY	5.4	6.4	12	5(42)	4(33)	3(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
14.	LO:NW-BAY	4.9	7.5	115	32(28)	67(58)	12(10)	2(2)	2(2)	0(0)	0(0)	0(0)	0(0)	1-10
15.	LO:EC-BAY	0.3	0.8	9	8(89)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	2.4	3.8	40	21(53)	18(45)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	4.2	5.2	8	3(38)	4(50)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	6.1	4.3	12	2(17)	8(67)	2(17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	5.5	7.1	29	6(21)	17(59)	4(14)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	7.0	8.6	28	5(18)	17(61)	2(7)	4(14)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	4.2	4.5	33	6(18)	24(73)	3(9)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	7.6	9.6	32	5(16)	18(56)	5(16)	3(9)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	8.3	5.2	3	0(0)	1(33)	2(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
24.	LO:GWB	6.0	8.2	23	5(22)	13(57)	4(17)	0(0)	1(4)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	11.3	9.1	10	1(10)	2(20)	5(50)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
26.	CY:NE-BAY	0.8	1.1	7	4(57)	3(43)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	4.5	5.8	67	20(30)	38(57)	7(10)	2(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	2.4	3.2	26	8(31)	17(65)	1(4)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
29.	CY:E-UP	5.9	12.0	29	11(38)	14(48)	2(7)	1(3)	0(0)	1(3)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	6.2	7.4	50	15(30)	23(46)	7(14)	5(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	5.5	5.8	30	7(23)	18(60)	5(17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	4.9	11.0	20	4(20)	14(70)	1(5)	0(0)	1(5)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	8.6	13.0	11	4(36)	4(36)	1(9)	1(9)	1(9)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	6.0	5.4	6	0(0)	4(67)	2(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	**13.0**	**17.0**	35	9(26)	12(34)	4(11)	6(17)	2(6)	1(3)	1(3)	0(0)	0(0)	1-10
36.	CY:GWB	5.8	6.1	29	6(21)	17(59)	5(17)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	6.6	7.6	52	4(8)	38(73)	7(13)	3(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	8.9	16.6	22	5(23)	13(59)	2(9)	0(0)	1(5)	0(0)	1(5)	0(0)	0(0)	1-10
39.	CY:C-ASS	6.5	7.2	20	3(15)	13(65)	2(10)	2(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	6.6	7.8	44	6(14)	29(66)	6(14)	3(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
41.	TR	**18.2**	**21.5**	109	8(7)	49(45)	17(16)	19(17)	7(6)	3(3)	3(3)	2(2)	1(1)	1-10
42.	TW	**10.6**	**11.2**	43	6(14)	20(47)	11(26)	5(12)	0(0)	1(2)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	**12.0**	**13.2**	11	3(27)	4(36)	2(18)	1(9)	1(9)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	6.5	2.3	3	0(0)	3(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
45.	LO:E-UP +TR	29.5	30.2	11	0(0)	4(36)	2(18)	3(27)	0(0)	0(0)	1(9)	1(9)	0(0)	11-20
46.	LO:BHR +TR	12.4	6.4	6	0(0)	2(33)	4(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
47.	LO:JRK +TR	**22.3**	**28.6**	13	3(23)	3(23)	3(23)	1(8)	1(8)	1(8)	0(0)	1(8)	0(0)	1-10
48.	LO:ORS +TR	**19.3**	**18.6**	9	1(11)	2(22)	3(33)	1(11)	1(11)	1(11)	0(0)	0(0)	0(0)	11-20
49.	LO:CTS +TR	3.6	4.5	8	2(25)	5(63)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	**13.5**	**20.0**	10	1(10)	6(60)	1(10)	0(0)	1(10)	1(10)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	**16.6**	**16.5**	10	1(10)	3(30)	3(30)	1(10)	2(20)	0(0)	0(0)	0(0)	0(0)	11-20
52.	LO:BD +TR	**39.3**	**28.0**	4	1(25)	0(0)	0(0)	0(0)	1(25)	2(50)	0(0)	0(0)	0(0)	51-65
53.	CY:NW-BAY+TR	**11.2**	**10.9**	16	0(0)	10(63)	2(13)	3(19)	1(6)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**16.4**	**13.6**	23	0(0)	8(35)	9(39)	4(17)	1(4)	1(4)	0(0)	0(0)	0(0)	11-20
55.	CY:BHR+TR	**24.3**	**22.8**	16	1(6)	7(44)	1(6)	1(6)	4(25)	1(6)	1(6)	0(0)	0(0)	1-10
56.	CY:JRK+TR	7.9	5.1	9	0(0)	7(78)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
57.	CY:ORS+TR	8.6	9.0	9	1(11)	5(56)	2(22)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
58.	CY:CTS+TR	**19.7**	**22.7**	4	0(0)	2(50)	1(25)	0(0)	0(0)	1(25)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	**14.4**	**11.4**	6	0(0)	3(50)	1(17)	2(33)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	12.6	8.5	16	0(0)	7(44)	8(50)	0(0)	1(6)	0(0)	0(0)	0(0)	0(0)	11-20
61.	CY:GWB+TR	**17.8**	**21.0**	9	0(0)	5(56)	0(0)	3(33)	0(0)	0(0)	1(11)	0(0)	0(0)	1-10
62.	CY:BD+TR	9.3	10.6	28	2(7)	19(68)	3(11)	3(11)	1(4)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	**17.4**	**14.7**	15	2(13)	3(20)	6(40)	3(20)	0(0)	1(7)	0(0)	0(0)	0(0)	11-20
64.	CY:NE-ASS+TR	**15.8**	**13.4**	29	1(3)	12(41)	6(21)	7(24)	3(10)	0(0)	0(0)	0(0)	0(0)	11-20
65.	CY:BHR+TW	6.6	8.7	7	3(43)	2(29)	1(14)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	**16.5**	**18.0**	5	0(0)	3(60)	1(20)	0(0)	1(20)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	6.6	3.9	10	1(10)	7(70)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	**17.1**	**14.6**	45	2(4)	17(38)	10(22)	9(20)	6(13)	1(2)	0(0)	0(0)	0(0)	11-20
69.	CY:NE-ASS+CY: NW-BAY	6.2	13.7	13	4(31)	7(54)	1(8)	0(0)	1(8)	0(0)	0(0)	0(0)	0(0)	1-10
	Total			1381	267(19)	714(52)	220(16)	109(8)	42(3)	16(1)	8(1)	4(0)	1(0)	

TABLE 18

Same as Table 4 but for Sub-Catchment No. 15

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	4.1	-	1	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
2.	CS:NW-BAY	**23.1**	**32.6**	2	1(50)	0(0)	0(0)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	No rain
3.	CS:WC-BAY	**26.6**	**24.5**	4	0(0)	1(25)	1(25)	1(25)	0(0)	1(25)	0(0)	0(0)	0(0)	11-20
4.	DP:NW-BAY	5.4	8.6	15	4(27)	9(60)	1(7)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	9.1	7.5	15	4(27)	3(20)	7(47)	1(7)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
6.	DP:EC-BAY	0.2	0.3	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	15.6	8.1	5	0(0)	1(20)	3(60)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
8.	DP:BD	1.5	2.1	2	1(50)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
9.	DP:JRK	**14.1**	**11.9**	9	0(0)	4(44)	1(11)	4(44)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
10.	DP:ORS	9.2	9.7	14	2(14)	7(50)	2(14)	3(21)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	2.8	4.8	8	3(38)	4(50)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	1.0	2.2	5	4(80)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
13.	LO:NE-BAY	3.5	4.8	12	5(42)	6(50)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
14.	LO:NW-BAY	6.2	9.3	115	37(32)	57(50)	11(10)	7(6)	3(3)	0(0)	0(0)	0(0)	0(0)	1-10
15.	LO:EC-BAY	0.2	0.7	9	8(89)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	2.9	5.2	40	20(50)	17(43)	2(5)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
17.	LO:E-UP	3.2	4.6	8	4(50)	3(38)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
18.	LO:BHR	6.2	7.7	12	3(25)	7(58)	1(8)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	6.9	12.1	29	12(41)	10(34)	5(17)	0(0)	2(7)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	2.6	3.3	28	10(36)	18(64)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	3.4	4.7	33	12(36)	18(55)	3(9)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	9.8	16.1	32	6(19)	19(59)	2(6)	2(6)	1(3)	2(6)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	6.3	5.5	3	1(33)	2(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
24.	LO:GWB	**12.9**	**17.6**	23	4(17)	12(52)	3(13)	1(4)	1(4)	2(9)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	**13.9**	**13.6**	10	1(10)	4(40)	2(20)	3(30)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	0.7	1.9	7	6(86)	1(14)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
27.	CY:NW-BAY	4.3	7.1	67	26(39)	33(49)	4(6)	4(6)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	3.6	8.5	26	16(62)	7(27)	2(8)	0(0)	1(4)	0(0)	0(0)	0(0)	0(0)	No rain
29.	CY:E-UP	7.0	13.9	29	12(41)	12(41)	3(10)	1(3)	0(0)	0(0)	1(3)	0(0)	0(0)	1-10
30.	CY:BHR	8.6	13.0	50	16(32)	20(40)	10(20)	1(2)	1(2)	2(4)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	6.8	9.7	30	12(40)	11(37)	3(10)	4(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	8.7	18.3	20	12(60)	4(20)	0(0)	2(10)	1(5)	0(0)	1(5)	0(0)	0(0)	No rain
33.	CY:CTS	**13.8**	**13.3**	11	2(18)	3(27)	4(36)	1(9)	1(9)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	9.9	20.4	6	1(17)	4(67)	0(0)	0(0)	0(0)	1(17)	0(0)	0(0)	0(0)	1-10
35.	CY:SHWB	**13.2**	**19.2**	35	9(26)	13(37)	3(9)	7(20)	1(3)	1(3)	0(0)	1(3)	0(0)	1-10
36.	CY:GWB	7.3	10.8	29	5(17)	18(62)	4(14)	1(3)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	9.8	12.9	52	13(25)	22(42)	9(17)	4(8)	4(8)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	**10.2**	**16.1**	22	7(32)	8(36)	4(18)	2(9)	0(0)	0(0)	1(5)	0(0)	0(0)	1-10
39.	CY:C-ASS	6.8	6.9	20	5(25)	9(45)	5(25)	1(5)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	9.9	15.6	44	13(30)	20(45)	4(9)	3(7)	3(7)	0(0)	1(2)	0(0)	0(0)	1-10
41.	TR	**21.5**	**24.3**	109	4(4)	41(38)	23(21)	21(19)	8(7)	6(6)	0(0)	3(3)	3(3)	11-20
42.	TW	**17.1**	**23.5**	43	8(19)	14(33)	10(23)	5(12)	2(5)	2(5)	0(0)	1(2)	1(2)	11-20
43.	LO:NW-BAY +TR	**12.1**	**16.1**	11	2(18)	5(45)	2(18)	0(0)	2(18)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	7.0	5.1	3	0(0)	2(67)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
45.	LO:E-UP +TR	**35.1**	**36.5**	11	1(9)	2(18)	2(18)	1(9)	2(18)	1(9)	1(9)	0(0)	1(9)	11-20
46.	LO:BHR +TR	**15.1**	**11.7**	6	0(0)	2(33)	2(33)	2(33)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
47.	LO:JRK +TR	**11.6**	**12.4**	13	3(23)	5(38)	2(15)	2(15)	1(8)	0(0)	0(0)	0(0)	0(0)	1-10
48.	LO:ORS +TR	**24.5**	**35.9**	9	2(22)	3(33)	1(11)	1(11)	0(0)	0(0)	1(11)	1(11)	0(0)	1-10
49.	LO:CTS +TR	3.4	4.2	8	2(25)	5(63)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	**10.8**	**16.3**	10	4(40)	2(20)	2(20)	1(10)	1(10)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	**17.9**	**23.7**	10	1(10)	6(60)	0(0)	1(10)	1(10)	0(0)	1(10)	0(0)	0(0)	1-10
52.	LO:BD +TR	**32.5**	**35.9**	4	1(25)	0(0)	1(25)	1(25)	0(0)	0(0)	0(0)	1(25)	0(0)	11-20
53.	CY:NW-BAY+TR	11.0	8.9	16	1(6)	8(50)	5(31)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**24.0**	**25.0**	23	1(4)	8(35)	6(26)	1(4)	5(22)	0(0)	1(4)	1(4)	0(0)	11-20
55.	CY:BHR+TR	**22.2**	**28.4**	16	1(6)	6(38)	4(25)	2(13)	0(0)	2(13)	0(0)	0(0)	1(6)	11-20
56.	CY:JRK+TR	13.5	9.1	9	0(0)	3(33)	5(56)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
57.	CY:ORS+TR	9.1	11.6	9	2(22)	4(44)	1(11)	2(22)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
58.	CY:CTS+TR	**41.6**	**52.1**	4	0(0)	1(25)	1(25)	1(25)	0(0)	0(0)	0(0)	0(0)	1(25)	11-20
59.	CY:E-MP+TR	**32.3**	**34.5**	6	0(0)	2(33)	2(33)	0(0)	0(0)	1(17)	0(0)	1(17)	0(0)	11-20
60.	CY:SHWB+TR	15.6	9.0	16	0(0)	5(31)	6(38)	5(31)	0(0)	0(0)	0(0)	0(0)	0(0)	21-35
61.	CY:GWB+TR	**24.5**	**37.8**	9	1(11)	4(44)	1(11)	1(11)	1(11)	0(0)	0(0)	0(0)	1(11)	1-10
62.	CY:BD+TR	**11.3**	**12.6**	28	3(11)	14(50)	7(25)	2(7)	2(7)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	**13.3**	**16.4**	15	2(13)	6(40)	5(33)	0(0)	1(7)	1(7)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	**22.9**	**20.7**	29	1(3)	10(34)	4(14)	8(28)	3(10)	1(3)	2(7)	0(0)	0(0)	11-20
65.	CY:BHR+TW	7.4	18.3	7	3(43)	3(43)	0(0)	0(0)	1(14)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	**16.0**	**13.9**	5	0(0)	2(40)	1(20)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
67.	CY:NE-ASS+TW	7.1	5.3	10	1(10)	5(50)	4(40)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	**21.1**	**22.7**	45	3(7)	16(36)	12(27)	4(9)	3(7)	4(9)	2(4)	1(2)	0(0)	11-20
69.	CY:NE-ASS+CY: NW-BAY	**10.4**	**18.9**	13	4(31)	5(38)	2(15)	1(8)	0(0)	0(0)	1(8)	0(0)	0(0)	1-10
	Total			1381	350(25)	580(42)	215(16)	124(9)	54(4)	27(2)	13(1)	10(1)	8(1)	

TABLE 19

Same as Table 4 but for Sub-Catchment No. 16

S. No.	System	Mean	S.D.	Freq.	AAP (mm) at different ranges with frequency of occurrence (probability of occurrence)									F/C range
					NR	1-10	11-20	21-35	36-50	51-65	66-80	81-100	>100	
1.	CS:NE-BAY	18.5	-	1	0(0)	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
2.	CS:NW-BAY	**17.1**	**11.1**	2	0(0)	1(50)	0(0)	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
3.	CS:WC-BAY	**15.6**	**16.2**	4	0(0)	2(50)	1(25)	0(0)	1(25)	0(0)	0(0)	0(0)	0(0)	1-10
4.	DP:NW-BAY	6.5	6.6	15	3(20)	7(47)	5(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
5.	DP:WC-BAY	5.0	6.4	15	6(40)	6(40)	3(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
6.	DP:EC-BAY	0.1	0.1	2	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
7.	DP:GWB	8.3	4.3	5	0(0)	4(80)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
8.	DP:BD	9.5	0.1	2	0(0)	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
9.	DP:JRK	7.3	7.4	9	1(11)	6(67)	1(11)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
10.	DP:ORS	9.4	10.0	14	1(7)	9(64)	2(14)	2(14)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
11.	DP:CTS	6.9	3.5	8	0(0)	7(88)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
12.	DP:E-MP	6.8	4.0	5	0(0)	4(80)	1(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
13.	LO:NE-BAY	6.9	8.2	12	2(17)	7(58)	2(17)	1(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
14.	LO:NW-BAY	8.4	11.2	115	25(22)	60(52)	17(15)	8(7)	4(3)	1(1)	0(0)	0(0)	0(0)	1-10
15.	LO:EC-BAY	1.4	2.9	9	6(67)	3(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	No rain
16.	LO:WC-BAY	5.3	5.7	40	11(28)	23(58)	6(15)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
17.	LO:E-UP	4.9	5.9	8	2(25)	5(63)	1(13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
18.	LO:BHR	9.4	8.0	12	2(17)	6(50)	2(17)	2(17)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
19.	LO:JRK	**12.3**	**12.0**	29	3(10)	14(48)	4(14)	7(24)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
20.	LO:ORS	8.9	8.9	28	2(7)	18(64)	5(18)	3(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
21.	LO:CTS	8.4	9.2	33	2(6)	22(67)	6(18)	2(6)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
22.	LO:E-MP	5.9	7.4	32	5(16)	21(66)	5(16)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
23.	LO:SHWB	**10.8**	**10.6**	3	0(0)	2(67)	0(0)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
24.	LO:GWB	9.7	11.1	23	3(13)	14(61)	2(9)	3(13)	1(4)	0(0)	0(0)	0(0)	0(0)	1-10
25.	LO:BD	6.2	4.6	10	2(20)	6(60)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
26.	CY:NE-BAY	3.3	2.8	7	1(14)	6(86)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
27.	CY:NW-BAY	9.0	8.4	67	5(7)	39(58)	17(25)	5(7)	1(1)	0(0)	0(0)	0(0)	0(0)	1-10
28.	CY:WC-BAY	6.6	7.7	26	8(31)	12(46)	4(15)	2(8)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
29.	CY:E-UP	6.4	6.3	29	5(17)	19(66)	4(14)	1(3)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
30.	CY:BHR	7.7	8.8	50	10(20)	23(46)	12(24)	4(8)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
31.	CY:JRK	7.2	7.1	30	2(7)	20(67)	6(20)	2(7)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
32.	CY:ORS	7.1	6.6	20	2(10)	11(55)	7(35)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
33.	CY:CTS	8.5	7.1	11	0(0)	8(73)	2(18)	1(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
34.	CY:E-MP	7.8	5.8	6	1(17)	2(33)	3(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
35.	CY:SHWB	5.7	6.3	35	4(11)	23(66)	8(23)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
36.	CY:GWB	7.9	7.7	29	3(10)	19(66)	4(14)	3(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
37.	CY:BD	8.4	9.3	52	6(12)	31(60)	10(19)	4(8)	1(2)	0(0)	0(0)	0(0)	0(0)	1-10
38.	CY:W-ASS	**10.1**	**14.3**	22	3(14)	13(59)	4(18)	1(5)	0(0)	0(0)	1(5)	0(0)	0(0)	1-10
39.	CY:C-ASS	**11.0**	**10.2**	20	1(5)	12(60)	2(10)	5(25)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
40.	CY:NE-ASS	9.7	10.1	44	4(9)	24(55)	11(25)	3(7)	2(5)	0(0)	0(0)	0(0)	0(0)	1-10
41.	TR	**12.5**	**11.6**	109	4(4)	63(58)	19(17)	18(17)	3(3)	2(2)	0(0)	0(0)	0(0)	1-10
42.	TW	9.0	11.1	43	6(14)	23(53)	11(26)	2(5)	0(0)	1(2)	0(0)	0(0)	0(0)	1-10
43.	LO:NW-BAY +TR	8.7	5.1	11	0(0)	7(64)	4(36)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
44.	LO:WC-BAY +TR	9.1	4.1	3	0(0)	2(67)	1(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
45.	LO:E-UP +TR	**17.1**	**39.8**	11	0(0)	9(82)	1(9)	0(0)	0(0)	0(0)	0(0)	0(0)	1(9)	1-10
46.	LO:BHR +TR	9.4	3.4	6	0(0)	4(67)	2(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
47.	LO:JRK +TR	**13.3**	**18.5**	13	0(0)	8(62)	2(15)	2(15)	0(0)	0(0)	1(8)	0(0)	0(0)	1-10
48.	LO:ORS +TR	**19.8**	**18.6**	9	0(0)	3(33)	2(22)	3(33)	0(0)	1(11)	0(0)	0(0)	0(0)	11-20
49.	LO:CTS +TR	4.9	2.9	8	1(13)	7(88)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
50.	LO:E-MP +TR	10.2	8.2	10	0(0)	6(60)	3(30)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
51.	LO:GWB +TR	11.4	7.7	10	0(0)	5(50)	4(40)	1(10)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
52.	LO:BD +TR	**35.8**	**34.5**	4	0(0)	1(25)	1(25)	0(0)	1(25)	0(0)	0(0)	1(25)	0(0)	11-20
53.	CY:NW-BAY+TR	**13.3**	**11.6**	16	0(0)	9(56)	4(25)	2(13)	1(6)	0(0)	0(0)	0(0)	0(0)	1-10
54.	CY:E-UP+TR	**16.9**	**29.8**	23	0(0)	13(57)	8(35)	0(0)	0(0)	0(0)	1(4)	0(0)	1(4)	1-10
55.	CY:BHR+TR	10.4	6.7	16	0(0)	9(56)	5(31)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
56.	CY:JRK+TR	11.5	5.8	9	0(0)	3(33)	6(67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	11-20
57.	CY:ORS+TR	8.3	5.7	9	0(0)	6(67)	3(33)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
58.	CY:CTS+TR	8.0	5.7	4	0(0)	3(75)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
59.	CY:E-MP+TR	7.4	5.1	6	0(0)	3(50)	3(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
60.	CY:SHWB+TR	11.5	13.1	16	0(0)	12(75)	2(13)	1(6)	0(0)	1(6)	0(0)	0(0)	0(0)	11-20
61.	CY:GWB+TR	8.2	8.8	9	0(0)	7(78)	1(11)	1(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
62.	CY:BD+TR	9.1	7.1	28	0(0)	18(64)	7(25)	3(11)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
63.	CY:W-ASS+TR	8.3	7.9	15	0(0)	12(80)	1(7)	2(13)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
64.	CY:NE-ASS+TR	**10.2**	**10.1**	29	1(3)	17(59)	7(24)	3(10)	1(3)	0(0)	0(0)	0(0)	0(0)	1-10
65.	CY:BHR+TW	4.4	6.6	7	3(43)	2(29)	2(29)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
66.	CY:GWB+TW	8.7	5.9	5	1(20)	2(40)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
67.	CY:NE-ASS+TW	9.5	8.9	10	0(0)	7(70)	1(10)	2(20)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
68.	TR+TW	10.7	9.8	45	1(2)	29(64)	8(18)	6(13)	0(0)	1(2)	0(0)	0(0)	0(0)	1-10
69.	CY:NE-ASS+CY: NW-BAY	10.7	9.7	13	0(0)	8(62)	3(23)	2(15)	0(0)	0(0)	0(0)	0(0)	0(0)	1-10
	Total			1381	150(11)	809(59)	276(20)	114(8)	19(1)	7(1)	3(0)	1(0)	2(0)	

5.15. *Sub-Catchment No. 15*

The detailed summary is shown in Table 18. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 350 days (25%), (*ii*) 1-10 mm for 580 days (42%), (*iii*) 11-20 mm for 215 days (16%), (*iv*) Remaining 17% of the total days were in the range of 21- 35 mm and more, (*v*) 21-35 mm for 124 days (9%) and (*vi*) remaining 112 days (8%) were in the range 36-50 mm and more.

(b) Three most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Depression over East-Central Bay and East MP respectively for 2(100%) and 4(80%) occasions, (*ii*) Low over East-Central Bay for 8(89%) occasions and (*iii*) CYCIR over NE Bay, WC Bay and Orissa respectively for 6(86%), 16(62%) and 12(60%) occasions.

(c) Nine (9) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Cyclonic Storm over NE Bay for a single occasion (100%), (*ii*) Depression over NW Bay for 9(60%) occasions, (*iii*) Low over Orissa and SHWB respectively for 18(64%), and 2(67%) occasions, (*iv*) CYCIR over East MP and GWB respectively for 4(67%) and 18(62%) occasions and (*v*) Trough passing through NER in association with Low over WC Bay, Chhattisgarh and GWB respectively for 2(67%), 5(63%) and 6(60%) occasions.

(d) There were four most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Depression over WC Bay and GWB for 7(47%) and 3(60%) occasions respectively, (*ii*) Trough passing through NER in association with CYCIR over Jharkhand for 5(56%) occasions and (*iii*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over NE Assam for 4(40%) occasions.

(e) There were nine most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Cyclonic Storm over WC Bay for single occasion (25%), (*ii*) Depression over Jharkhand for 4(44%) occasions, (*iii*) Low over Bangladesh for 3(30%) occasions, (*iv*) Trough passing through NER in association with Low over Bihar and Bangladesh respectively for 2 (33%) and 1 (25%) occasions, (*v*) Trough passing through NER in association with CYCIR over Chhattisgarh, SHWB and NE Assam respectively for 1 (25%), 5 (31%) and 8 (28%) occasions and (*vi*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over GWB for 2 (40%) occasions.

(f) There were seven most important systems favourable (25% or more) producing AAP in the range 36-50 mm or more. Those were (*i*) Cyclonic Storm over NW Bay and WC Bay for 1(50%) and 1(25%) occasions respectively, (*ii*) Trough passing through NER in association with Low over East UP and Bangladesh for 5(45%) and 1(25%) occasions respectively and (*iii*) Trough passing through NER in association with CYCIR over East UP, Chhattisgarh and East MP for 7(30%), 1(25%) and 2(33%) occasions respectively.

5.16. *Sub-Catchment No. 16*

The detailed summary is shown in Table 19. The results are as follows:

(a) During the study period, it has been found that the AAP in the range of (*i*) "No Rain" for 150 days (11%), (*ii*) 1-10 mm for 809 days (59%), (*iii*) 11-20 mm for 276 days (20%), (*iv*) remaining days were in the range of 21- 35 mm and more, (*v*) 21-35 mm for 114 days (8%) and (*vi*) remaining 32 days (2%) were in the range 36-50 mm and more.

(b) Three most important synoptic systems favourable (60% or more cases) for producing AAP of "No Rain" were (*i*) Depression over East-Central Bay for twice (100%) and (*ii*) Low over East-Central Bay for 6(67%) occasions.

(c) Thirty seven (37) most important synoptic systems favourable (60% or more cases) for producing AAP of "1-10" mm were (*i*) Depression over GWB, Bangladesh, Jharkhand, Orissa, Chhattisgarh and East MP respectively for 4 (80%), 2 (100%), 6 (67%), 9 (64%), 7 (88%) and 4(80%) occasions, (*ii*) Low over East UP, Orissa, Chhattisgarh, East Madhya Pradesh, SHWB, GWB and Bangladesh respectively for 5 (63%), 18 (64%), 22 (67%), 21 (66%), 2 (67%), 14 (61%) and 6 (60%) occasions, (*iii*) CYCIR over East UP, Jharkhand, Chhattisgarh, SHWB, GWB, Bangladesh and Central Assam respectively for 19 (66%), 20 (67%), 8 (73%), 23 (66%), 19 (66%), 31 (60%) and 12 (60%) occasions, (*iv*) Trough passing through NER in association with Low over NW Bay, WC Bay, East UP, Bihar, Jharkhand, Chhattisgarh and East MP respectively for 7 (64%), 2 (67%), 9 (82%), 4 (67%), 8 (62%), 7 (88%) and 6 (60%) occasions, (*v*) Trough passing through NER in association with CYCIR over Orissa, Chhattisgarh, SHWB, GWB, Bangladesh and West Assam respectively for 6 (67%), 3 (75%), 12 (75%), 7 (78%), 18 (64%) and 12(80%) occasions each, (*vi*) Trough passing through NER in association with Trough in Westerlies between 85° E - 89° E north of 20° N for 29 (64%) occasions and (*vii*) CYCIR over NW Bay in combination with another CYCIR over NE Assam for 8 (62%) cases.

TABLE 20

Percentage occurrence of AAP due to with and without presence of Trough over NER

Sub-catchment No.	"No rain"		1-10 mm		11 mm & above	
	Without trough (%)	With trough (%)	Without trough (%)	With trough (%)	Without trough (%)	With trough (%)
1.	48	14	40	42	12	44
2.	35	11	49	49	16	40
3.	35	8	50	48	15	44
4.	29	7	46	47	25	46
5.	30	6	53	53	17	41
6.	23	5	55	53	22	42
7.	34	19	54	62	12	19
8.	26	6	54	54	20	40
9.	30	6	51	45	19	49
10.	42	17	46	48	12	35
11.	31	13	58	70	11	17
12.	19	3	65	58	16	39
13.	44	13	44	52	12	35
14.	25	8	55	45	20	47
15.	34	10	44	38	22	52
16.	15	4	58	60	27	36

TABLE 21

Verification Report of QPF based on SAT for the year 2011

Catchment No.	Correct occasions (%)	One stage out occasions (%)		Two stage out occasions (%)	
		Up	Down	Up	Down
1.	60(44)	34(25)	20(15)	20(15)	02(01)
2.	58(43)	23(17)	43(32)	09(07)	03(02)
3.	63(46)	26(19)	31(23)	14(10)	02(01)
4.	50(37)	33(24)	43(32)	09(07)	01(01)
5.	77(57)	27(20)	25(18)	07(05)	00(00)
6.	67(49)	27(20)	35(26)	07(05)	00(00)
7.	93(68)	11(08)	28(21)	04(03)	00(00)
8.	80(59)	18(13)	26(19)	12(09)	00(00)
9.	76(56)	15(11)	34(25)	08(06)	03(02)
10.	77(57)	21(15)	35(26)	03(02)	00(00)
11.	99(73)	07(05)	27(20)	03(02)	00(00)
12.	96(71)	18(13)	17(13)	05(04)	00(00)
13.	78(57)	23(17)	32(24)	02(01)	01(01)
14.	80(59)	19(14)	25(18)	10(07)	02(01)
15.	58(43)	25(18)	38(28)	13(10)	02(01)
16.	100(74)	15(11)	17(13)	04(03)	00(00)

(d) There were six most important systems favourable (40% or more) producing AAP in the range 11-20 mm. Those were (*i*) Cyclonic Storm over NE Bay for a single occasion (100%), (*ii*) CYCIR over East MP for 3(50%) occasions, (*iii*) Trough passing through NER in association with Low over GWB for 4 (40%) occasions, (*iv*) Trough passing through NER in association with CYCIR over Jharkhand and East MP respectively for 6 (67%) and 3 (50%) occasions and (*v*) Trough in Westerlies between 85° E - 89° E north of 20° N in association with CYCIR over GWB for 2(40%) occasions.

(e) There were four most important systems favourable (25% or more) producing AAP in the range 21-35 mm. Those were (*i*) Cyclonic Storm over NW Bay for a single occasion (50%), (*ii*) Low over SHWB for a single occasion (33%), (*iii*) CYCIR over Central Assam for 5(25%) occasions and (*iv*) Trough passing through NER in association with Low over Orissa for 3(33%) occasions.

(f) There were two most important systems favourable (25% or more) producing AAP in the range 36-50 mm or more. Those were (*i*) Cyclonic Storm over WC Bay for 1(25%) occasions and (*ii*) Trough passing through NER in association with Low over Bangladesh for 2(50%) occasions.

6. Validation

The model outputs are validated with the realised daily AAPs during the flood season 2011. The verification in quantitative terms is given in Table 21. The three sub-catchments of Brahmaputra basin where the forecast is accurate by 60% are adjacent and two of them are in Central Assam and the other is at plains of West Assam. Climatologically, Central Assam is known for receiving less rainfall whereas plains of West Assam are famous for receiving higher rainfall. The correctness of the forecast in the sub-catchment areas which fall in the east Arunachal Pradesh and adjoining NE Assam are in the ranges 43-46% and out by two stages are in the ranges 9-16%. The lowest percentage of correctness of forecast among all the catchment areas is found in sub-catchment No. 4 and is 37% only. The catchments where the forecast accuracy

TABLE 22

Different Skill scores of the verification of QPF based on SAT for the year 2011

Catchment No.	Skill scores						
	POD	FAR	MR	C-NON	CSI	TSS	HSS
1.	0.40	0.50	0.60	0.86	0.27	0.36	0.26
2.	0.30	0.59	0.70	0.75	0.17	0.17	0.05
3.	0.42	0.65	0.58	0.81	0.20	0.20	0.19
4.	0.33	0.67	0.67	0.66	0.17	0.00	-0.02
5.	0.39	0.56	0.61	0.68	0.26	0.16	0.08
6.	0.33	0.50	0.67	0.66	0.18	0.15	-0.01
7.	0.53	0.41	0.47	0.52	0.37	0.36	0.07
8.	0.40	0.27	0.60	0.69	0.26	0.54	0.11
9.	0.38	0.50	0.62	0.69	0.24	0.25	0.08
10.	0.36	0.61	0.64	0.67	0.24	0.06	0.02
11.	0.37	0.42	0.63	0.68	0.29	0.33	0.06
12.	0.40	0.21	0.60	0.69	0.30	0.62	0.10
13.	0.40	0.60	0.60	0.69	0.27	0.09	0.09
14.	0.30	0.56	0.70	0.77	0.21	0.24	0.07
15.	0.33	0.68	0.67	0.79	0.19	0.13	0.13
16.	0.37	0.29	0.63	0.71	0.29	0.57	0.11

lies below 50% are sub-catchment No. 1, 2, 3, 4, 6 and 15. The most of the areas of these sub-catchments except sub-catchment No. 15 are mountainous as depicted in Table 2. The sub-catchments where the forecast accuracy lies between 50% and 60% are sub-catchment No. 5, 8, 9, 10, 13 and 14. The catchments where the forecast accuracy is more than 60% are sub-catchments No. 7, 11, 12 and 16. The sub-catchments where the forecast out by two stages and greater than 10% are 1, 3 and 15. In all these sub-catchments, the rainfall is mainly dominated by the orographic and convective rain. Therefore, it can be concluded that the model is successful to a large extent in issuing QPF objectively.

The details of different skill scores calculated by 2×2 contingency table are given in Table 22. The POD in most of the sub-catchments is 40% or less than 40%. But it is more than 50% in sub-catchment No. 7 only. Missing rate is as high as 60% in almost all the sub-catchments except sub-catchment No. 3 & 7 where it is 58% and 47% respectively. FAR for sub-catchment No. 7, 8, 11, 12 are 0.41, 0.21, 0.42 and 0.21 respectively and in rest of the sub-catchments it is either 0.50 or more. The C-NON is 52% in sub-catchment No.7 and in remaining all other sub-catchments it is more than 66%. BIAS is higher than 10% in sub-catchment No. 7, 11 and 12 and in remaining sub-catchments it is below 10%. The PC in different catchments is shown in [Figs. 3(a&b)]. The PC is 59% in sub-catchment No. 4 and in remaining all other sub-catchments it is more than 68%. It is Maximum for sub-catchment No. 16 and is more than 84%. Thus from above, it may be concluded that SAT is not an absolute method for predicting QPF over the study area, however, the model can predict QPF with reasonably higher confidence.

7. Discussions

Whenever any synoptic systems like low, depression, CYCIR etc are associated with trough passing through NER, the rainfall intensity increases or AAPs are in the higher range. For rainfall over NER, trough of low, axis of monsoon trough passing through NER is the predominant factor. From Tables (4-19), it is observed that there are few synoptic situations with frequency 10 or more for which the standard deviation (SD) of realised AAPs are 10 mm or more. The mean of observed AAPs for these situations are also large irrespective of the location of sub-catchment. The synoptic systems like low, depression formed over Bay of Bengal generally moves in north-westerly direction and seldom affects NER except proximity of these systems to NER. The most favourable situations for such high AAPs with large SD are trough of low, axis of monsoon trough passing through NER or trough of low, axis of monsoon trough passing through NER in association with the CYCIR and low located west of NER. For sub-catchment No. 1, out of the 14 situations with frequency 10 or more for which the mean and SD of realised AAPs of 10 mm or more, 11 situations are either due to trough of low or monsoon trough passing through NER or low in association with trough passing through NER or CYCIR in association with trough passing through NER; *i.e.*, more than 78% of the occasions are either due to trough of low or monsoon trough passing through NER or low in association with trough passing through NER or CYCIR in association with trough passing through NER. For rest of the sub-catchments, it is 100%, 82%, 80%, 92%, 100%, 100%, 80%, 85%, 100%, 100%, 100%, 90%, 86%, 63% and 70% respectively. In other words, AAPs under such synoptic situations is highly variable. The presence of trough passing through NER increases the rainfall activity. Occurrence of "No

Rain" decreases sharply and percentage frequencies of AAPs in the range "11-20" mm and above increases considerably irrespective of the location of the sub-catchments. The details are shown in Table 20. Thus, issuance of QPF under the above mentioned synoptic situations always need attention and there is high uncertainty in correctness of QPF predicted by the model under such synoptic conditions.

Correctness of QPF over hilly terrain is still a great challenge to the forecaster worldwide and the same is also true for NER. SAT for QPF may be reasonably successful but may not be successful to that extent for predicting orographic and convective rain. But each may have considerable influence on the total precipitation processes and thus affects the calculation of AAPs for each catchment. Moreover unlike other meteorological parameters, rainfall is highly variable quantity. Only a few rain gauges do not constitute an adequate sample of a large catchment area for quantitative purposes. The sparse observatory network over the river catchment areas of the NER may be considered as one of the most important bottle neck for estimating AAPs. AAPs are one of the components of a QPF model developed by SAT. Thus for better QPF model by SAT, a good dense observatory network is essential over NER. The performance of the QPF model based on SAT for river catchment areas of NER is reasonably good in spite of the above constraints.

8. Conclusions

From the above study, the following broad conclusions can be drawn:

(*i*) Sixty nine (69) different synoptic conditions have been identified and are responsible for AAPs in different ranges in all the sixteen sub-catchments of river Brahmaputra and the river Barak as shown in Tables (4-19) and may be used as a tool for issuing QPF.

(*ii*) Presence of monsoon trough or trough of low passing over NER and its association with other synoptic systems like CYCIR, low, depression etc are the dominant factor for causing AAPs in the higher range and warrants for issue of QPF in the range 11-20 mm or higher.

(*iii*) The presence of trough of low/monsoon trough passing through NER or trough of low/monsoon trough passing through NER in association with the synoptic systems like cycir, low, depression etc. enhances the mean AAPs and the variability increases in all the sixteen sub-catchments.

(*iv*) The frequency of "No Rain" is the maximum in the sub-catchments No. 1, 10 and 13, whereas it is minimum in the sub-catchments No. 12 and 16 respectively.

(*v*) Frequency of occurrence of AAP in the range 36-50 mm and above is the maximum in the sub-catchment No. 15 (112) and is minimum in sub-catchments No. 11(9).

(*v*) The PC of QPF is the minimum in sub-catchment No. 4 (59%) and is the maximum in in sub-catchment No. 11(78%) in the Brahmaputra Basin and In the Barak basin, the PC is 84% in sub-catchment No. 16. The model can predict QPF with reasonably higher confidence.

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References

Abbi, S. D. S., Singh, R., Khanna, B. S. and Katyal, K. N., 1979, "Forecasting of (Semi) quantitative precipitation over Bhagirathi catchments by synoptic analogue method", *Vayu Mandal*, Jan- June, 16-22.

Ali, M., Singh, U. P. and Joardar, D., 2011, "QPF model for lower Yamuna catchment, synoptic analogue method", *Mausam*, **62**, 1, 27-40.

Lal, J., Dey, J. S. and Kapoor, K. K., 1983, "Semiquantive precipitation forecast for Gomti catchments by synoptic analogue method", *Mausam*, **34**, 3, 309-312.

Raha, G. N., Bhattacharjee, K., Joardar, A., Mallik, R., Dutta, M. and Chaktaborty, T. K., 2009, "Quantitative Precipitation Forecast (QPF) for Teesta basin and heavy rainfall warning over Teesta basin & adjoining areas in North Bengal & Sikkim using synoptic analogue method", *Mausam*, **60**, 4, 491-504.

Rao, D. V. L. N, Anand, C. M. and Kundra, M. D., 1970, "Quantitative precipitation forecasting over small catchments area by the method of synoptic typing", *Indian J. Met Geophys*., **21**, 4, 501-598.

Rao, G. S., Sarkar, M. B. and Chakraborty, D. D., 1997, "Semi-quantitative precipitation forecast for Teesta basin by synoptic analogue method", *Vayu Mandal*, Jul-Dec, 36-39.

Singh, K. M., Prasad, M. C., Prasad, G., Prasad, R. and Jha, M. K., 2010a, "Semi-quantitative precipitation forecasts for Koshi/ Mahananda catchment by synoptic analogue method", *Mausam*, **61**, 2, 175-186.

Singh, K. M., Prasad, M. C. and Prasad, G., 2010b, "Semi-quantitative precipitation forecasts for Bagmati/Adhwara group of rivers/ Kamala Balan catchments by synoptic analogue technique", *Mausam*, **61**, 3, 337-348.