Bangladesh Water Development Board



RAINFALL IN BANGLADESH YEAR: 2019 & 2020.





October 2021

Surface Water Processing Branch BWDB, 72 Green Road, Dhaka.

Bangladesh Water Development Board



SUMMARY OF RAINFALL IN BANGLADESH FOR THE YEARS 2019 & 2020.

October 2021

Prepared & Published by:

Surface Water Processing Branch BWDB, 72 Green Road, Dhaka.

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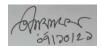
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PREFACE

BWDB's Hydrology has now an operational network of Hydro-Geological Stations covering Surface Water, Ground water, River Morphology, and Processing and Flood Forecasting Circle. All these activities are organized by three Circles and one Directorate under Chief Engineer, Hydrology, BWDB, Dhaka. Processing and Flood Forecasting Circle, BWDB, Dhaka is one of those three circles. This circle has five Divisions headed by four Executive Engineers & one Deputy Director.

Surface Water Processing Branch is one of the Branches/Divisions under Processing and Flood Forecasting Circle which is receiving surface water related data from different Hydrological field offices. After getting the hard copy of data, this branch is responsible for data entry, processing & archiving all soft data in the database server. Quality control of data, validation, and archiving the data along with additional secondary information for different user groups is a vital responsibility of the Processing Branch of Hydrology. Simultaneously it has been felt to conduct research work to analyze the trend on the changes of the Surface Water Hydrology of Bangladesh. As such the Surface Water Processing Branch prepared a report name "Summary of Rainfall in Bangladesh for the period 2017 & 2018". This initiative has been taken in this context for 2nd time which will continue in the future.

This report "Summary of Rainfall in Bangladesh for the period 2019 & 2020" is an attempt to find out the Quantity of Rainfall in Bangladesh for the last two year's rainfall.

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EXECUTIVE SUMMARY

The principal purpose of this report is to find out the variation of rainfall volume in various districts in Bangladesh for the period of 2019 and 2020. It has been found that maximum rainfall occurs at Sunamganj district during the years 2019 and 2020 which are 3810.35 mm and 4862.85 mm respectively. In 2019, the lowest rainfall was observed at Faridpur district (1086.25 mm), and in 2020, the lowest rainfall was observed at Madaripur District (1189.55 mm). Whereas station-wise maximum rainfall was recorded 6060.50 mm (Sunamgonj, CL127) and 6550.00 mm (Natore, Gurudaspur, CL14) in 2019 & 2020 respectively. On the other hand, station-wise minimum rainfall was recorded 130.60 mm (Rangpur, Pirgacha, CL202) and 220.70 mm (Rangpur, Pirgacha, CL202) in 2019 & 2020 respectively

The range of average annual rainfall for different districts varies from 1086.25 mm to 3810.35 mm in 2019 and 1189.55 mm to 4862.85 mm in 2020 approximately. The average annual rainfall for the country in 2019 is 1974.45mm and in 2020 it is 2284.70mm. The total rainfall volume is 302725.93 Mm3 and 342341.88 Mm3 in 2019 and 2020 respectively. In our previous report, we find out that total rainfall in 2017 & 2018 is 409533.58 Mm³ and 272274.64 Mm³ respectively.

The seasonal variation of total rainfall in 2019 & 2020 can be described as 65.50% to 69.52% of the total annual rainfall occurs in monsoon, 12.45% to 8.75% occurs in postmonsoon, 3.59% to 1.30% occurs in winter, and 18.45% to 20.42% occurs in summer.

ACRONYMS

BWDB	Bangladesh Water Development Board
GW	Ground Water
MAFt	Million Acre Feet
Mm ³	Million Meter Cube.
PFFC	Processing and Flood Forecasting Circle
PWD	Public Works Department
RMPB	River Morphology Processing Branch
SW	Surface Water
SWPB	Surface Water Processing Branch
TWL	Tidal Water Level
WARPO	Water Resource Planning Organization
mm	Millimetre.

TABLE OF CONTENTS

EXECU	TIVE SUMMARY	iv
ACRON	VYMS	iv
Chapte	er 1 Introduction	1
1.1	Background	1
1.2	Required Data	1
1.3	Sources of Data	1
1.4	Rainfall Stations	3
Chapte	er 2 Estimation of Rainfall	4
2.1	Rainfall of Bangladesh	4
2.2	Rainfall Volume and Statistics	6
2.3	Rainfall Volume for the years 2019 & 2020.	8
Chapte	er 3 Seasonal Rainfall	11
3.1	Seasonal Variation of rainfall 2019	11
3.2	Seasonal Variation of rainfall 2020	17
Chapte	er 4 Findings and Discussions	23
4.1	Summary of Rainfall Resources:	23
4.2	Conclusion	28
REFERE	ENCES	28
APPEN	IDIX	29

LIST OF TABLES

Table No	Description	Page
Table 1.1	Hydrological Network of BWDB	1
Table 2.1	Rainfall Volume in 64 Districts of Bangladesh for the year 2019 & 2020.	6-7
Table 3.1	Average Seasonal variation of Rainfall during 2019 (District wise)	10-11
Table 3.2	Average Seasonal variation of Rainfall during 2020 (District wise)	16-17

LIST OF FIGURES

Figure No	Description	Page
Figure 1.1	Rainfall Stations of BWDB	2
Figure 2.1	Average Climate of Bangladesh	4
Figure 2.2a to 2.2b	Rainfall map 2019 & 2020	8-9
Figure 3.1a	Rainfall map, Summer 2019	12
Figure 3.1b	Rainfall map, Monsoon 2019	13
Figure 3.1c	Rainfall map, Post Monsoon 2019	14
Figure 3.1d	Rainfall map, Winter 2019	15
Figure 3.2a	Rainfall map, Summer 2020	18
Figure 3.2b	Rainfall map, Monsoon 2020	19
Figure 3.2c	Rainfall map, Post Monsoon 2020	20
Figure 3.2d	Rainfall map, Winter 2020	21
Figure 4.1a to 4.1b	District wise annual rainfall of 2019	22
Figure 4.2a to 4.2b	District wise annual rainfall of 2020	23
Figure 4.3a to 4.3b	District wise annual rainfall of 2019 and 2020	24
Figure 4.4	Monthly rainfall of 2019	25
Figure 4.5	Monthly rainfall of 2020	25
Figure 4.6	Seasonal variation rainfall of 2019	26
Figure 4.7	Seasonal variation rainfall of 2020	26

Chapter 1 **Introduction**

1.1 Background

Climate change due to global warming is a major concerning issue in the world. Rainfall is changing on global and regional scales by the influence of warming. Due to global warming, hydrological changes are the most significant impacts of climate change in Bangladesh. Rainfall is an important component of climate, and an unbalanced distribution of rainfall can yield excess or scarcity of water resources. Rainfall intensity, amounts, and variation are expected to change, and extreme weather events such as droughts and floods are likely to occur more frequently. Almost every year Bangladesh suffers scarcity of water in dry monsoon and excess of water in monsoon which sometimes leads to flood. Rainfall and its intensity are important factors on the Bangladesh climate for agricultural production as well as food security.

Surface Water Processing Branch does entry, process and sends data to the database server after receiving all data collected by field divisions of Hydrology. After receiving data from field offices, validity checks and publishing reports are also some major activities of the processing branch. In our previous report "Summary of Rainfall in Bangladesh for the period 2017 & 2018", we measured the rainfall of Bangladesh in 2017 and 2018, and in continuation of that, we will measure to find out the rainfall of Bangladesh in 2019 and 2020 in this report.

1.2 Required Data

Water occurs on the earth in all its three stages, viz, liquid, solid, & gaseous, and in various degrees of motion. Most of the water in our country comes through the cross-boundary rivers and another major portion of water comes from rainfall. In this study Rainfall data for the year 2019 & 2020 are analysed.

1.3 Sources of Data

Field offices under Chief Engineer, Hydrology of Bangladesh Water Development Board (BWDB) collect, process, and store the Hydrological Data of Bangladesh. BWDB maintains a strong hydrologic network throughout the country for the collection of different types of hydrological data. Rainfall and Evaporation data are collected daily basis. Rainfall in mm is measured once a day (at 09:00 AM) throughout the year. Data collected from the fields are processed and stored in the database maintained by the Processing Circle of BWDB. All the data used in this study are extracted from the central database of BWDB. Details of these networks are showing in the following table:

Table 1.1: Hydrological Network of BWDB

SL	Database	Type Code	Data Type Name	Remarks
1	SW	NTWL	Non-Tidal SW Level	
2	SW	TDWL	Tidal SW Level	
3	SW	NTQ	Non-Tidal Observed Discharge	
4	SW	TDQ	Tidal Observed Discharge	
5	SW	SWQ	Surface Water Quality	
6	SW	SA	Salinity	
7	RM	CS	River Cross Section	
8	SW	SED	Sediment	
9	CL	RF	Rainfall	
10	CL	CL	Climatology	
11	CL	EV	Evaporation	
12	GW	GT	Weekly GW Table	
13	GW	GT Daily	Daily GW Table	
14	GW	GQ	GW Quality	

Source: BWDB Database

1.4 Rainfall Stations

In this report we consider 274 rainfall stations situated in 64 districts of Bangladesh, which are shown in the flowing map (*Station name & ID shown in Appendix*):

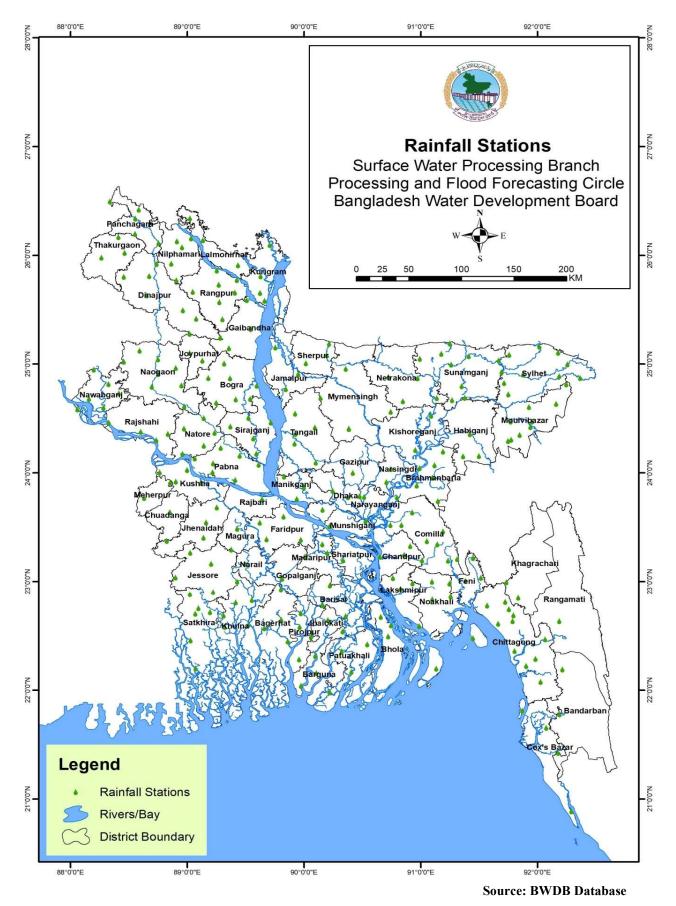


Figure 1.1: Map showing BWDB's Rainfall Stations.

Chapter 2 **Estimation of Rainfall**

2.1 Rainfall of Bangladesh

Bangladesh extends from N20°34' to N26°38' latitude and from E88°01' to E92°41' longitude which lies in the tropical monsoon region and the climate is characterized by high temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations. Bangladesh enjoys generally a subtropical monsoon climate. While there are six seasons in a year, three namely, winter, summer, and monsoon are prominent. Winter, which is quite pleasant, begins in November and ends in February. The summer starts in March and is extended up to May. The monsoon starts in June and stays up to September.

In winter there is not usually much fluctuation in temperature which ranges from a minimum of 5⁰-12⁰ Celsius to a maximum of 22⁰-31⁰ Celsius. The maximum temperature recorded in summer usually is 36° Celsius, However, in some places, this occasionally raises to 41^{0} Celsius or more. The monsoon period accounts for 80% of the total annual rainfall. The average annual rainfall varies from 2100 to 5100 millimetres. The maximum rainfall is recorded in the coastal areas of Chittagong and the northern part of Sylhet district, while the minimum is observed in the western and northern parts of the country. Cyclonic storms with a wind velocity of more than 120 km/hr occur with the advent of the monsoon season. These are particularly severe just before and after the monsoon, in May and October; winds of over 160 km/hr velocity, heavy downs pour and tidal surges of over 6 m above the normal level have brought devastation to life and property more than once in the recent past. Maximum evaporation in Bangladesh occurs during the summer (March-May), the highest evaporation generally occurs during April. The mean monthly evaporation varies from 51 mm in winter to 183 mm in summer. The rate of evaporation in the eastern part is generally lower than in the western and north-western parts. Humidity ranges between 60% in the dry season and 98% during the monsoon.

South-eastern zone (A): It comprises the Chittagong sub-region and a strip of land extending from southwest Sundarbans to the south of Cumilla. The hills over 300 m in height have a southeastern zone climate. The rest of the area has a small range of temperature, rarely goes over a mean of 32°C and below a mean of 13°C. Rainfall is heavy, usually over 2,540 mm. In winter dewfall is heavy.

North-eastern zone (B): This zone includes most of the eastern and southern part of the Sylhet division and a wedge-shaped strip south of the Meghalaya Plateau.

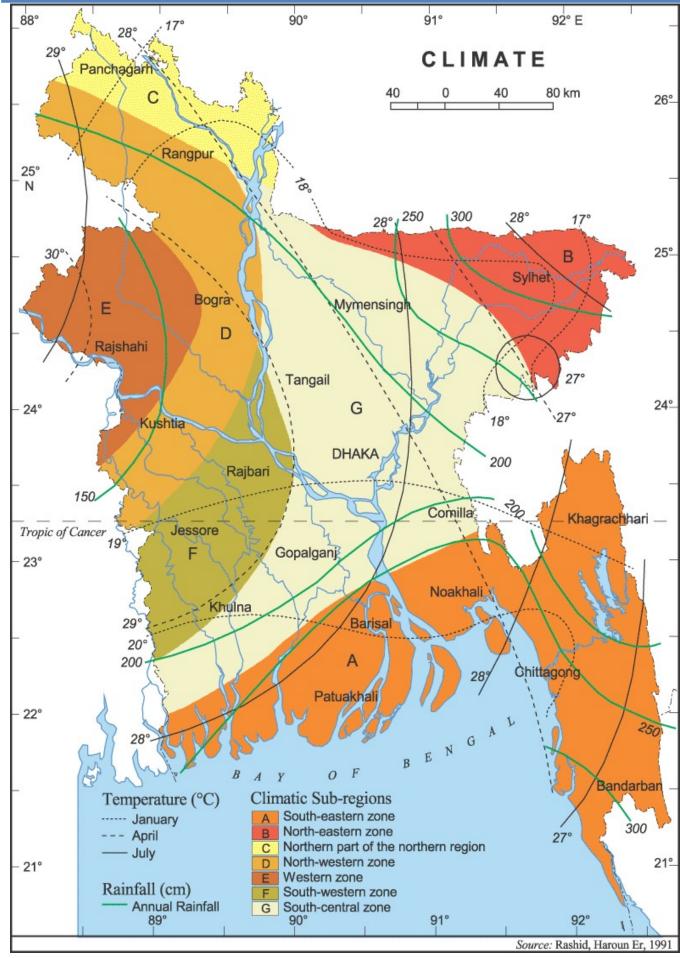


Figure 2.1: Average Climate of Bangladesh

Here, the mean maximum temperature is rarely above 32°C but the mean minimum is 10°C and below. Average humidity is even more than in the south-eastern zone. In this zone winter rain is appreciable. Fog is very common in winter. This is the cloudiest part of Bangladesh. The higher hills and mountains of the Chittagong sub-region can also be classified under this zone.

The northern part of the northern region (C): This is an area of extremes. In summer the mean maximum temperature is well above 32°C whereas in winter the mean minimum is below 10°C. The summer is dry, with a scorching westerly wind, but the rainy season is very wet, with 2000 mm to 3000 mm of rainfall.

North-western (D): The extremes are less, and the rainfall is lower, this zone is similar to the northern part of the northern region. The lower rainfall makes this area both atmospherically and pedologically drier.

Western zone (E): It comprises the greater Rajshahi district and parts of adjacent districts. This is the driest area in Bangladesh with rainfall generally below 1500 mm and summer humidity less than 50%. In summer, it is the hottest and driest of all climatic zones. The mean summer maximum temperature is over 35°C.

South-western zone (F): Here the extremes of the zones to the north are somewhat tempered. Rainfall varies from 1500 mm to 1800 mm. The mean summer maximum temperature is below 35°C. Dew-fall is heavier than in the Western zone.

South-central zone (G): In this zone rainfall is abundant, being above 1900 mm. The range of temperature is, as can be expected, much less than to the west, but somewhat more than in the South-eastern zone. This is a transitory zone between the South-eastern, North-western, and South-western zones, and most of the severe hailstorms, nor'westers, and tornadoes are recorded in this area.

2.2 Rainfall Volume and Statistics

Monthly Rainfall Volume has been estimated all the available rainfall data in BWDB for the years 2019 & 2020. The rainfall volume has been calculated as the product of annual average rainfall and the district area, then presented in Million m³. It has been found that on average maximum rainfall occurs during the years 2019 & 2020 at Sunamganj district.

The lowest rainfall was observed during the year 2019 at Faridpur District and the year 2020 at Madaripur District. Total rainfall volume during 2019 & 2020 has been presented in the following table.

Table 2.1: Rainfall Volume in 64 Districts of Bangladesh for the year 2019 & 2020.

SI.	District	District Area (km²)	Annual avg. RL'2019	Annual avg. RL'2020	Rainfall Volume'2019 (Million m³)	Rainfall Volume'2020 (Million m³)	Remarks
1	Bagerhat	3960	2326.88	2565.70	9214.43	10160.17	
2	Bandarban	4480	2816.97	2546.43	12620.01	11408.02	
3	Barguna	1832	2561.80	2891.83	4693.22	5297.84	
4	Barisal	2790	1874.28	2288.13	5229.23	6383.87	
5	Bhola	3403	1927.03	2326.40	6557.69	7916.74	
6	Bogra	2920	1350.44	1669.23	3943.29	4874.15	
7	Brahmanbaria	1927	1710.62	2141.43	3296.37	4126.54	
8	Chandpur	1704	1705.46	2343.53	2906.11	3993.37	
9	Chittagong	5285	2452.92	2327.50	12963.66	12300.84	
10	Chuadanga	1158	1281.70	1716.75	1484.21	1988.00	
11	Comilla	3084	3794.43	3150.30	11702.03	9715.53	
12	Cox's Bazar	2492	1869.79	2293.13	4659.51	5714.49	
13	Dhaka	1464	1719.90	1690.38	2517.93	2474.71	
14	Dinajpur	3439	1677.29	2311.09	5768.19	7947.83	
15	Faridpur	2072	1086.25	1525.23	2250.71	3160.27	
16	Feni	1125	1852.80	2515.43	2084.40	2829.86	
17	Gaibandha	2179	1704.50	2233.33	3714.11	4866.43	
18	Gazipur	1741	1879.93	1817.13	3272.96	3163.63	
19	Gopalganj	1490	2129.00	1611.00	3172.21	2400.39	
20	Habiganj	2636	2094.18	1994.80	5520.25	5258.29	
21	Jamalpur	2032	1874.93	1939.80	3809.86	3941.67	
22	Jessore	2567	1641.26	1680.36	4213.11	4313.48	
23	Jhalokathi	758	3330.50	3627.10	2524.52	2749.34	
24	Jhenaidah	1961	1244.08	1991.30	2439.63	3904.91	
25	Joypurhat	965	1446.80	1889.13	1396.16	1823.01	
26	Khagrachhari	2699	2082.30	1838.85	5620.13	4963.06	
27	Khulna	4317	1926.58	1868.26	8317.05	8065.28	
28	Kishoreganj	2689	1476.89	1550.38	3971.35	4168.96	
29	Kurigram	2296	2384.85	3112.03	5475.62	7145.21	
30	Kushtia	1620	1909.18	2401.48	3092.86	3890.39	
31	Lakshmipur	1456	2803.63	3713.14	4082.08	5406.32	
32	Lalmonirhat	1242	1680.83	2922.73	2087.60	3630.03	
33	Madaripur	1145	1404.15	1189.55	1607.75	1362.03	
34	Magura	1049	1173.30	1346.60	1230.79	1412.58	
35	Manikganj	1378	1434.00	1975.00	1976.05	2721.55	
36	Meherpur	716	1422.55	1664.94	1018.55	1192.10	
37	Moulvi Bazar	2799	2612.14	2489.77	7311.39	6968.86	
38	Munshiganj	955	2064.69	1848.10	1971.78	1764.94	
39	Mymensingh	4362	1806.51	2430.50	7879.99	10601.86	
40	Naogaon	3640	1572.39	1753.94	5723.50	6384.35	
41	Narail	917	1311.00	1469.00	1202.19	1347.07	
42	Narayanganj	759	1718.00	1849.80	1303.96	1404.00	

SI.	District	District Area (km²)	Annual avg. RL'2019	Annual avg. RL'2020	Rainfall Volume'2019 (Million m³)	Rainfall Volume'2020 (Million m³)	Remarks
43	Narsingdi	1141	2018.85	1971.45	2303.51	2249.42	
44	Natore	1895	1933.68	2501.64	3664.32	4740.61	
45	Nawabganj	1702	1329.82	1476.02	2263.35	2512.19	
46	Netrokona	2810	2375.07	2713.13	6673.96	7623.90	
47	Nilphamari	1642	2164.48	3324.10	3554.08	5458.17	
48	Noakhali	3601	2327.08	3608.04	8379.82	12992.55	
49	Pabna	2371	1415.90	1503.19	3357.10	3564.05	
50	Panchagarh	1404	2308.32	3534.52	3240.88	4962.47	
51	Patuakhali	3205	2594.90	3399.53	8316.64	10895.48	
52	Pirojpur	1308	2152.00	2177.50	2814.82	2848.17	
53	Rajbari	1119	2238.20	3069.20	2504.55	3434.43	
54	Rajshahi	2407	1420.12	1555.44	3418.23	3743.94	
55	Rangamati	6116	1888.40	1395.40	11549.45	8534.27	
56	Rangpur	2308	1515.49	2030.41	3497.74	4686.20	
57	Satkhira	3858	1934.70	1517.02	7464.07	5852.67	
58	Shariatpur	1182	2181.30	2264.50	2578.30	2676.64	
59	Sherpur	1364	2420.63	2708.70	3301.74	3694.67	
60	Sirajganj	2498	1340.16	1678.96	3347.71	4194.04	
61	Sunamganj	3670	3810.35	4862.85	13983.97	17846.66	
62	Sylhet	3489	3580.65	4091.75	12492.89	14276.12	
63	Tangail	3414	1409.36	1611.04	4811.56	5500.09	
64	Thakurgaon	1809	1869.52	2715.97	3380.84	4913.18	
	Total =	147816			302725.93	342341.88	

Total = 147816 302725.93 342341.88 (km²) Million m³ Million m³

2.3 Rainfall Volume for the years 2019 & 2020.

The annual average rainfall in the country during the year 2019 is 1974.45mm, which is equivalent to a depth of 2.048m. The annual average rainfall in the country during the year 2020 is 2284.70mm, which is equivalent to a depth of 2.316m

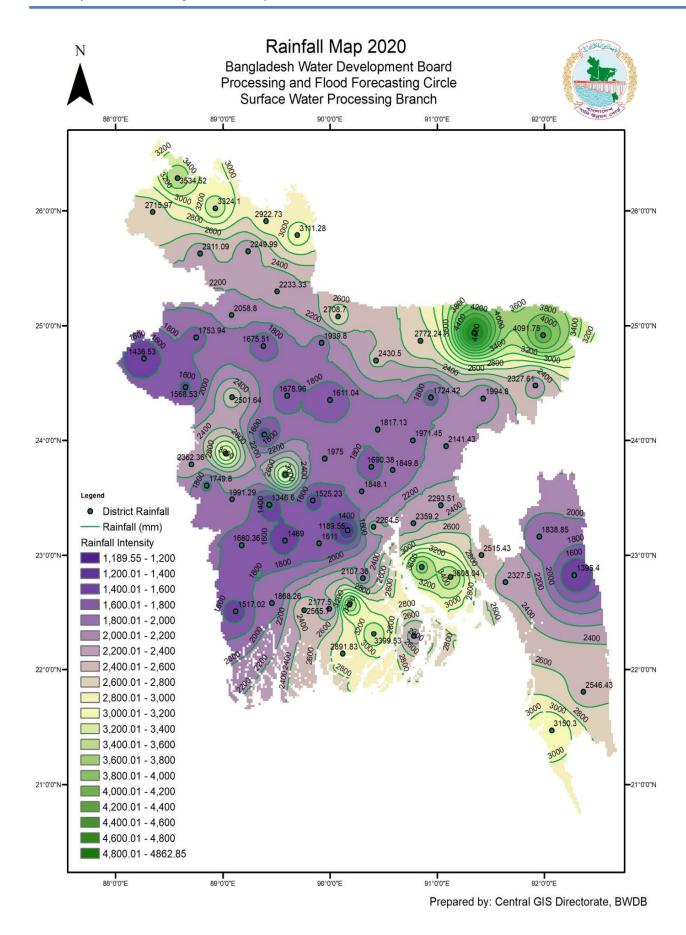


Figure 2.2(a): Rainfall map 2019 (Annual Average Rainfall 2019)

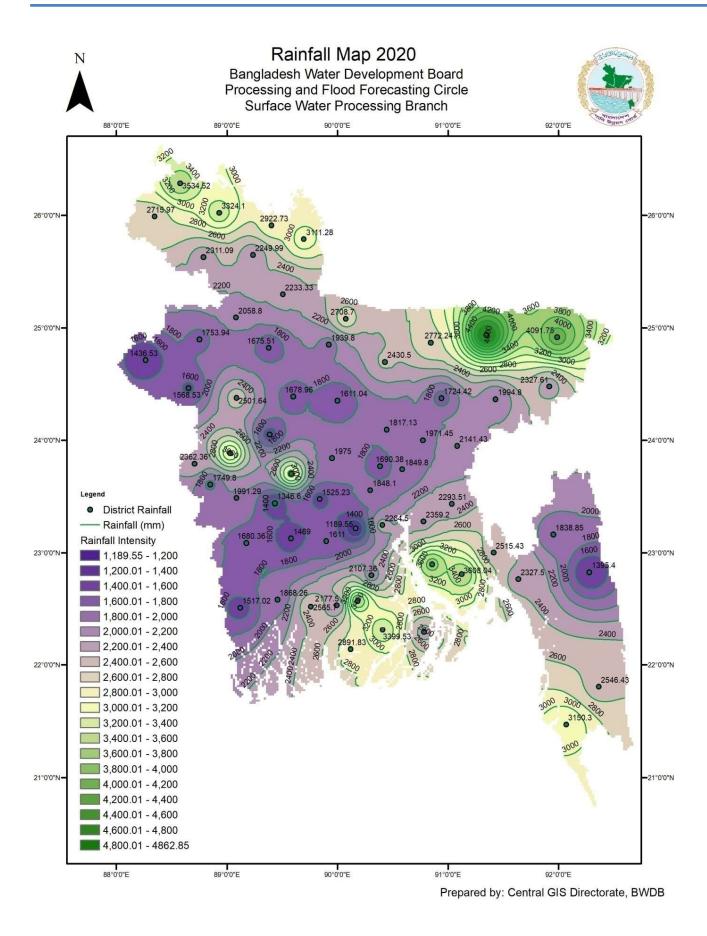


Figure 2.2(b): Rainfall map 2020 (Annual Average Rainfall 2020)

Chapter 3 **Seasonal Rainfall**

Hydrological parameters show different values in different seasons. Specially rainfall volume changes abruptly in different seasons in Bangladesh. For calculating Seasonal variation of the years 2019 & 2020, we consider the Hydrological calendar of BWDB which are as below:

Summer - March, April, and May

Monsoon - June, July, August, and September.

Post-Monsoon - October and November.

Winter - December, January, and February.

3.1 Seasonal Variation of rainfall 2019

The calculated values of seasonal & annual average rainfall (mm) distribution of 64 Districts and monthly & annual total rainfall (mm) in the years 2019 & 2020 are shown in the following Table: 3.1 & 3.2 and also graphical presentation on figure 3.1(a) to 3.1(d).

SL No	District	Summer	Monsoon	Post Monsoon	Winter	Annual Total
1	Bagerhat	269.75	1410.08	480.15	166.90	2326.88
2	Bandarban	242.00	2199.37	349.37	26.23	2816.97
3	Barguna	227.50	1733.23	532.97	68.10	2561.80
4	Barisal	247.63	1052.15	478.25	96.25	1874.28
5	Bhola	297.33	1258.03	306.00	65.67	1927.03
6	Bogra	358.03	778.49	183.27	30.66	1350.44
7	Brahmanbaria	393.88	1076.78	180.97	58.98	1710.62
8	Chandpur	302.63	1072.00	243.49	87.35	1705.46
9	Chittagong	322.45	1868.85	215.30	46.31	2452.92
10	Chuadanga	314.05	625.35	249.75	92.55	1281.70
11	Cox's Bazar	294.97	3376.07	97.90	25.50	3794.43
12	Cumilla	350.25	1168.75	258.51	92.30	1869.79
13	Dhaka	477.50	938.45	202.05	101.90	1719.90
14	Dinajpur	257.74	1243.36	144.54	31.65	1677.29
15	Faridpur	244.50	607.38	154.38	80.00	1086.25
16	Feni	257.70	1297.30	204.27	93.53	1852.80
17	Gaibandha	316.00	1099.83	254.00	34.67	1704.50
18	Gazipur	319.60	1278.80	211.77	69.77	1879.93
19	Gopalganj	368.50	1209.00	332.00	219.50	2129.00
20	Habiganj	565.18	1342.08	149.23	37.70	2094.18
21	Jamalpur	470.53	1110.77	273.30	20.33	1874.93
22	Jessore	317.66	972.22	199.78	151.60	1641.26
23	Jhalokathi	304.60	2180.00	685.70	160.20	3330.50
24	Jhenaidah	217.63	769.25	172.70	84.50	1244.08

SL No	District	Summer	Monsoon	Post Monsoon	Winter	Annual Total
25	Joypurhat	270.55	957.15	184.00	35.10	1446.80
26	Khagrachhari	304.75	1530.30	194.80	52.45	2082.30
27	Khulna	231.98	1147.58	389.86	157.16	1926.58
28	Kishoreganj	267.75	1016.14	153.25	39.75	1476.89
29	Kurigram	629.68	1549.13	189.43	16.63	2384.85
30	Kushtia	430.53	1008.45	402.63	67.58	1909.18
31	Lakshmipur	425.98	1814.55	463.65	99.45	2803.63
32	Lalmonirhat	371.40	1179.60	114.27	15.57	1680.83
33	Madaripur	277.70	763.65	235.85	126.95	1404.15
34	Magura	181.75	676.45	176.30	138.80	1173.30
35	Manikganj	414.50	792.75	151.75	75.00	1434.00
36	Meherpur	355.55	754.75	254.85	57.40	1422.55
37	Moulvi Bazar	802.86	1587.86	187.57	33.86	2612.14
38	Munshiganj	170.13	1637.04	157.76	99.77	2064.69
39	Mymensingh	423.82	1137.72	215.03	29.95	1806.51
40	Naogaon	272.07	1084.58	174.68	41.08	1572.39
41	Narail	201.00	811.00	186.00	113.00	1311.00
42	Narayanganj	402.00	942.00	285.00	89.00	1718.00
43	Narsingdi	564.70	1131.10	267.15	55.90	2018.85
44	Natore	433.00	1185.04	248.26	67.38	1933.68
45	Nawabganj	217.64	899.86	175.76	36.56	1329.82
46	Netrokona	613.66	1512.13	219.52	29.77	2375.07
47	Nilphamari	494.18	1559.10	79.42	31.78	2164.48
48	Noakhali	329.74	1538.56	363.08	95.70	2327.08
49	Pabna	384.96	770.26	219.10	41.59	1415.90
50	Panchagarh	419.68	1819.12	56.72	12.80	2308.32
51	Patuakhali	314.20	1757.50	450.73	72.48	2594.90
52	Pirojpur	287.23	1342.03	421.68	101.08	2152.00
53	Rajbari	391.00	1355.90	302.00	189.30	2238.20
54	Rajshahi	286.82	879.52	201.02	52.76	1420.12
55	Rangamati	202.00	1536.00	92.00	58.40	1888.40
56	Rangpur	322.20	1077.01	99.14	17.13	1515.49
57	Satkhira	260.02	1209.05	312.27	153.37	1934.70
58	Shariatpur	475.40	1327.90	291.50	86.50	2181.30
59	Sherpur	563.30	1545.23	291.13	20.97	2420.63
60	Sirajganj	259.19	858.93	163.48	58.56	1340.16
61	Sunamganj	866.03	2626.05	292.47	25.80	3810.35
62	Sylhet	913.88	2346.38	282.88	37.53	3580.65
63	Tangail	365.96	851.90	153.38	38.12	1409.36
64	Thakurgaon	179.13	1588.63	76.70	24.43	1869.52
A	Annual Average	364.30	1293.37	245.87	70.91	1974.45

Table 3.1: Average Seasonal variation of Rainfall during 2019 (District wise)

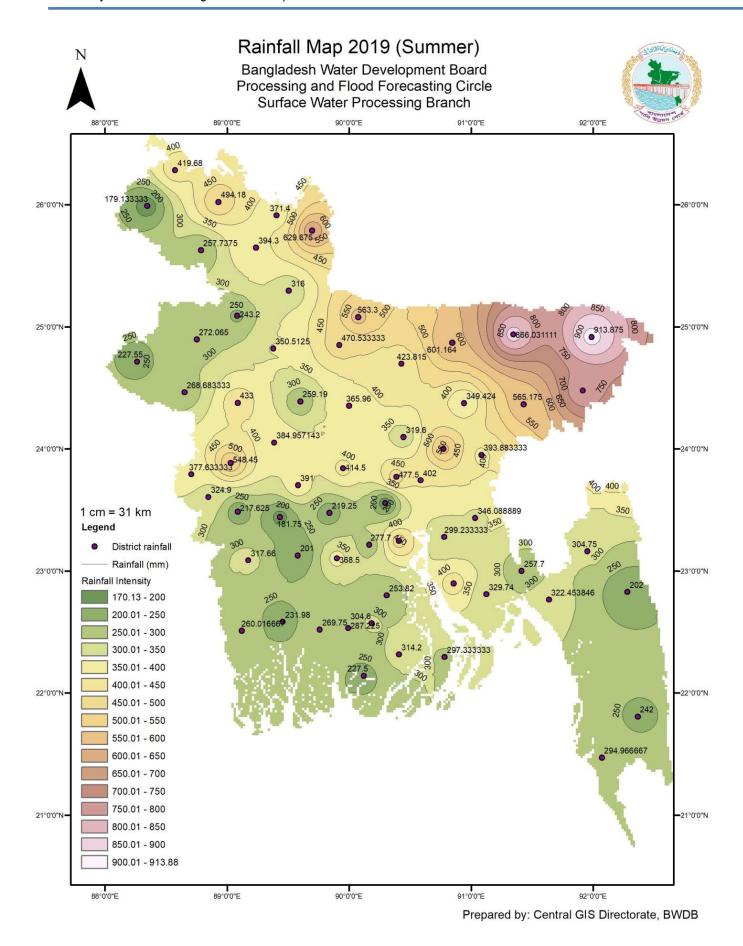


Figure 3.1(a): Rainfall map, summer 2019 (Average rainfall March, April and May of 2019)

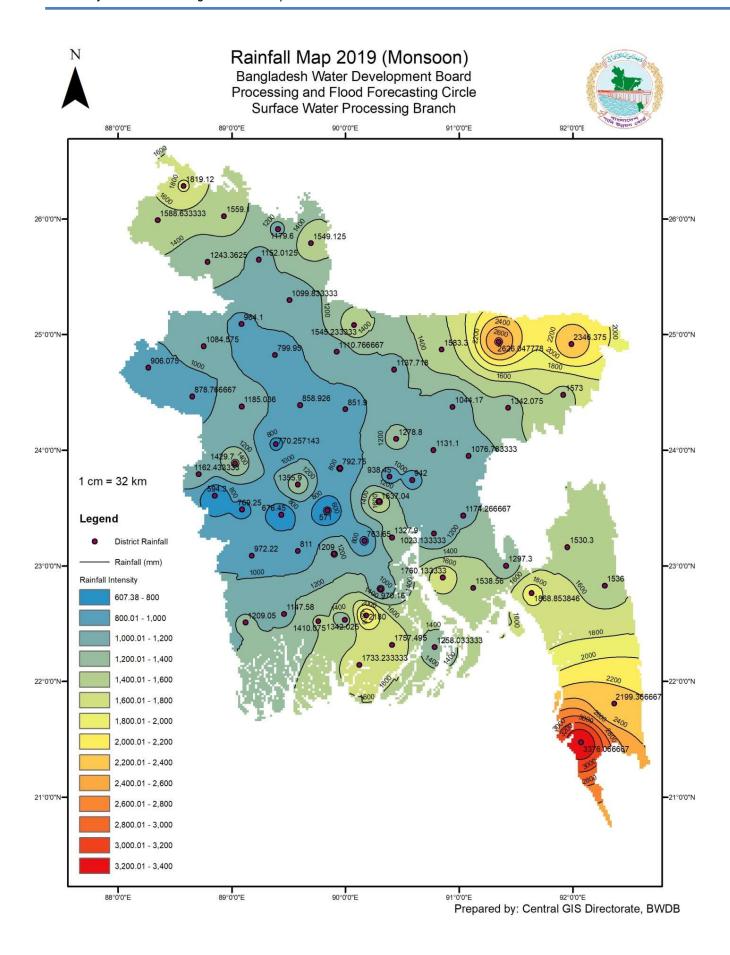


Figure 3.1(b): Rainfall map, Monsoon 2019 (average rainfall June, July, August and September of 2019)

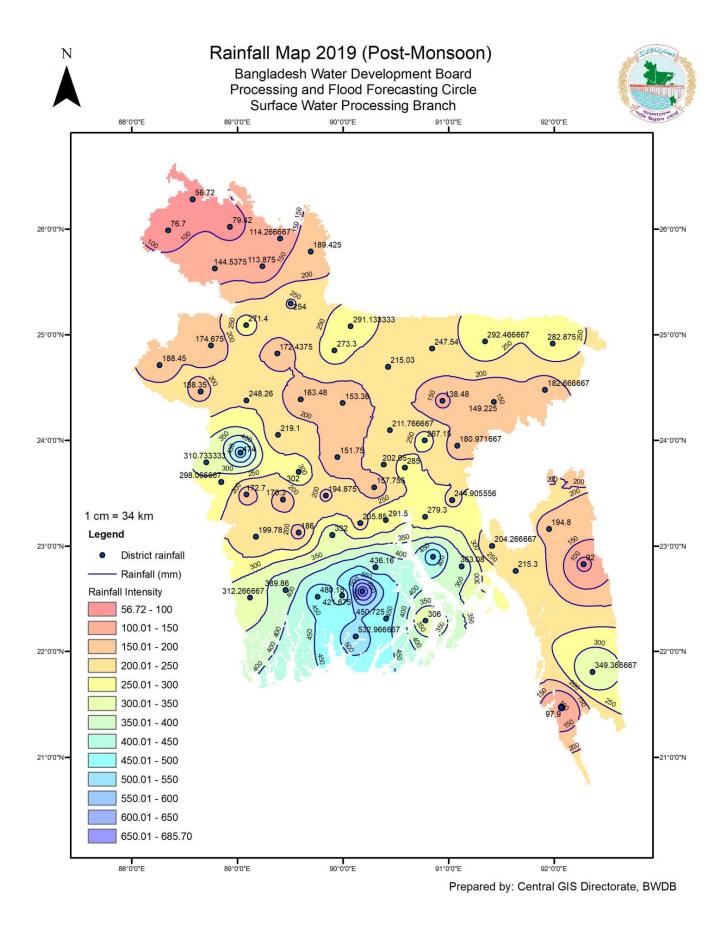


Figure 3.1(c): Rainfall map, Post Monsoon 2019 (Average rainfall October and November of 2019)

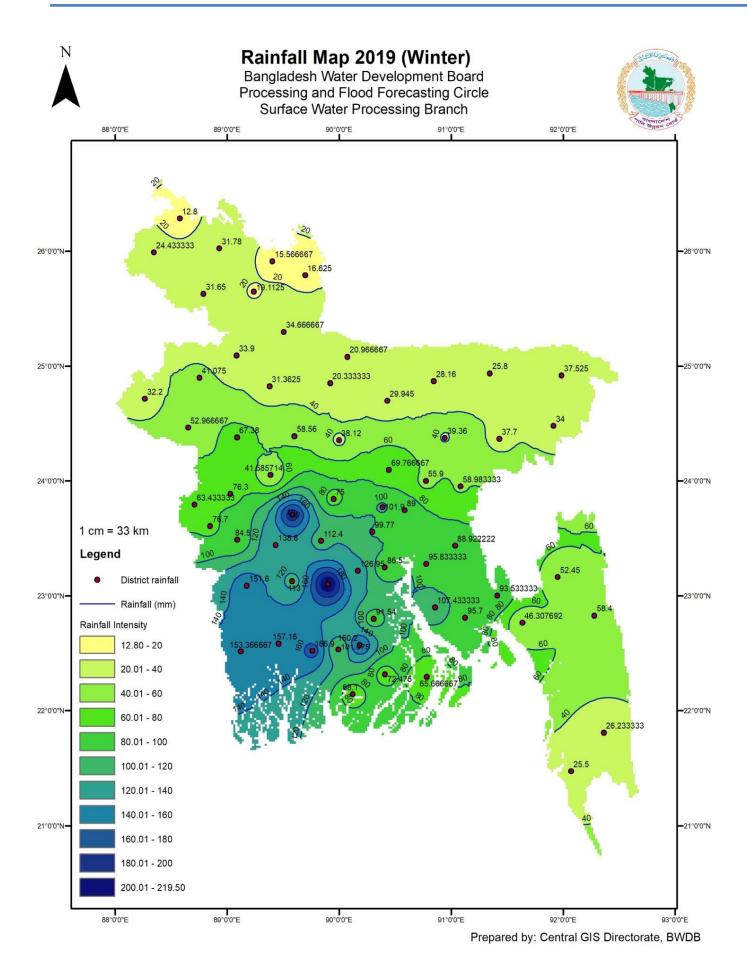


Figure 3.1(d): Rainfall map, Winter 2019 (Average rainfall December, January and February of 2019)

3.2 Seasonal Variation of rainfall 2020

SL No	District	Summer	Monsoon	Post Monsoon	Winter	Annual Total
1	Bagerhat	494.98	1702.98	325.38	42.38	2565.70
2	Bandarban	330.60	1764.17	374.87	76.80	2546.43
3	Barguna	336.80	2174.93	340.33	39.77	2891.83
4	Barisal	422.25	1546.38	274.75	44.75	2288.13
5	Bhola	308.33	1613.73	361.67	42.67	2326.40
6	Bogra	382.57	1152.19	124.20	10.27	1669.23
7	Brahmanbaria	544.73	1382.53	178.83	35.33	2141.43
8	Chandpur	428.03	1607.10	245.70	62.70	2343.53
9	Chittagong	332.09	1678.14	281.34	35.93	2327.50
10	Chuadanga	377.55	1237.95	78.55	22.70	1716.75
11	Cox's Bazar	282.00	2653.80	211.37	3.13	3150.30
12	Cumilla	466.51	1498.98	261.48	66.16	2293.13
13	Dhaka	451.13	923.78	299.10	16.38	1690.38
14	Dinajpur	450.23	1769.96	79.25	11.65	2311.09
15	Faridpur	403.88	964.23	140.75	16.38	1525.23
16	Feni	487.50	1694.77	270.33	62.83	2515.43
17	Gaibandha	517.83	1621.50	89.00	5.00	2233.33
18	Gazipur	354.47	1165.23	266.03	31.40	1817.13
19	Gopalganj	481.50	1021.00	83.00	25.50	1611.00
20	Habiganj	553.70	1243.83	182.63	14.65	1994.80
21	Jamalpur	444.37	1327.43	160.00	8.00	1939.80
22	Jessore	384.52	1167.78	97.16	30.90	1680.36
23	Jhalokathi	607.30	2579.90	375.50	64.40	3627.10
24	Jhenaidah	603.38	1271.91	95.40	20.60	1991.30
25	Joypurhat	467.10	1321.23	81.85	18.95	1889.13
26	Khagrachhari	329.45	1174.75	317.15	17.50	1838.85
27	Khulna	351.94	1366.10	125.92	24.30	1868.26
28	Kishoreganj	429.00	919.40	162.10	39.88	1550.38
29	Kurigram	972.58	2047.68	83.23	8.55	3112.03
30	Kushtia	615.78	1535.40	221.70	28.60	2401.48
31	Lakshmipur	452.58	2591.39	541.98	127.20	3713.14
32	Lalmonirhat	500.43	2282.90	126.73	12.67	2922.73
33	Madaripur	354.70	702.25	113.80	18.80	1189.55
34	Magura	360.45	861.65	103.85	20.65	1346.60
35	Manikganj	469.25	1276.75	200.00	29.00	1975.00
36	Meherpur	367.60	1157.99	119.85	19.50	1664.94
37	Moulvi Bazar	660.06	1589.49	230.00	10.22	2489.77
38	Munshiganj	428.40	1220.40	179.95	19.35	1848.10
39	Mymensingh	567.14	1653.10	201.75	8.51	2430.50
40	Naogaon	394.50	1236.38	104.61	18.45	1753.94
41	Narail	459.00	902.00	98.00	10.00	1469.00
42	Narayanganj	456.30	1197.00	186.00	10.50	1849.80
43	Narsingdi	612.45	1168.45	166.75	23.80	1971.45
44	Natore	429.10	1944.62	90.70	37.22	2501.64
45	Nawabganj	250.96	1102.06	87.90	35.10	1476.02
46	Netrokona	539.02	1970.18	191.97	11.97	2713.13

SL No	District	Summer	Monsoon	Post Monsoon	Winter	Annual Total
47	Nilphamari	731.48	2526.40	47.70	18.52	3324.10
48	Noakhali	502.10	2492.96	510.06	102.92	3608.04
49	Pabna	380.03	968.46	135.19	19.51	1503.19
50	Panchagarh	382.02	3095.80	19.26	37.44	3534.52
51	Patuakhali	438.18	2362.28	558.48	40.60	3399.53
52	Pirojpur	358.78	1468.15	304.20	46.38	2177.50
53	Rajbari	749.70	2019.60	244.50	55.40	3069.20
54	Rajshahi	280.56	1131.66	124.50	18.72	1555.44
55	Rangamati	198.40	1081.00	116.00	0.00	1395.40
56	Rangpur	468.84	1500.03	57.09	4.46	2030.41
57	Satkhira	344.62	1057.92	76.68	37.80	1517.02
58	Shariatpur	695.50	1259.00	253.50	56.50	2264.50
59	Sherpur	518.20	1991.33	186.67	12.50	2708.70
60	Sirajganj	422.28	980.18	249.08	27.42	1678.96
61	Sunamganj	727.11	3654.75	457.60	23.39	4862.85
62	Sylhet	763.63	2971.25	340.00	16.88	4091.75
63	Tangail	525.40	908.88	161.06	15.70	1611.04
64	Thakurgaon	463.57	2198.47	23.40	30.53	2715.97
Ann	ual Average	466.63	1588.34	199.96	29.78	2284.70

Table: 3.2: Average Seasonal variation of Rainfall during 2020 (District wise)

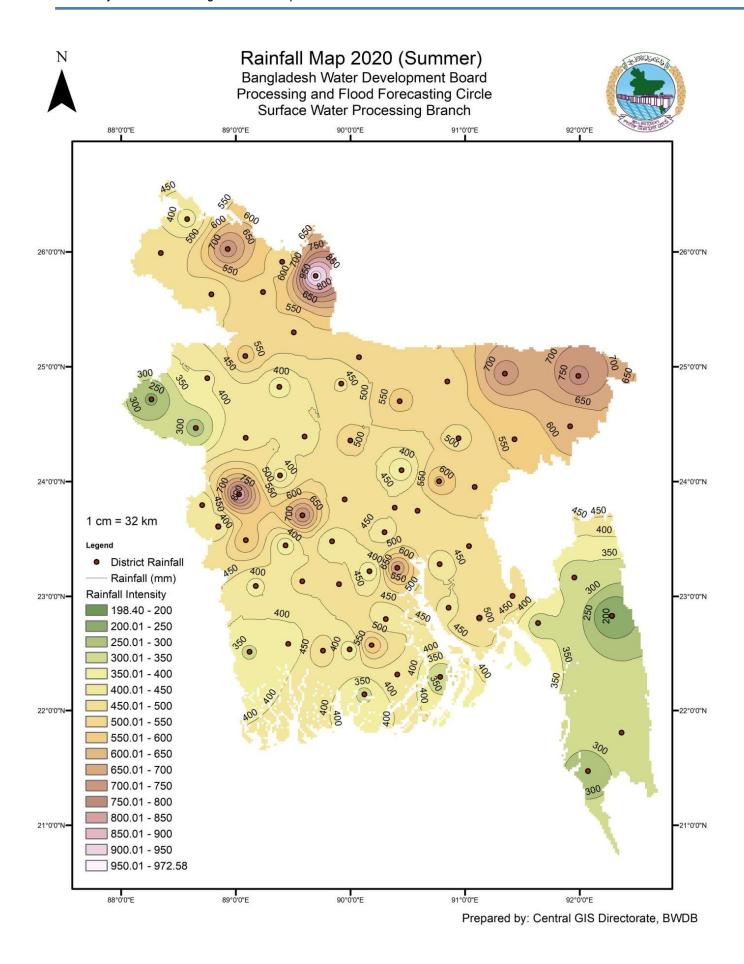


Figure 3.2(a): Rainfall map, summer 2020 (Average rainfall March, April and May of 2020)

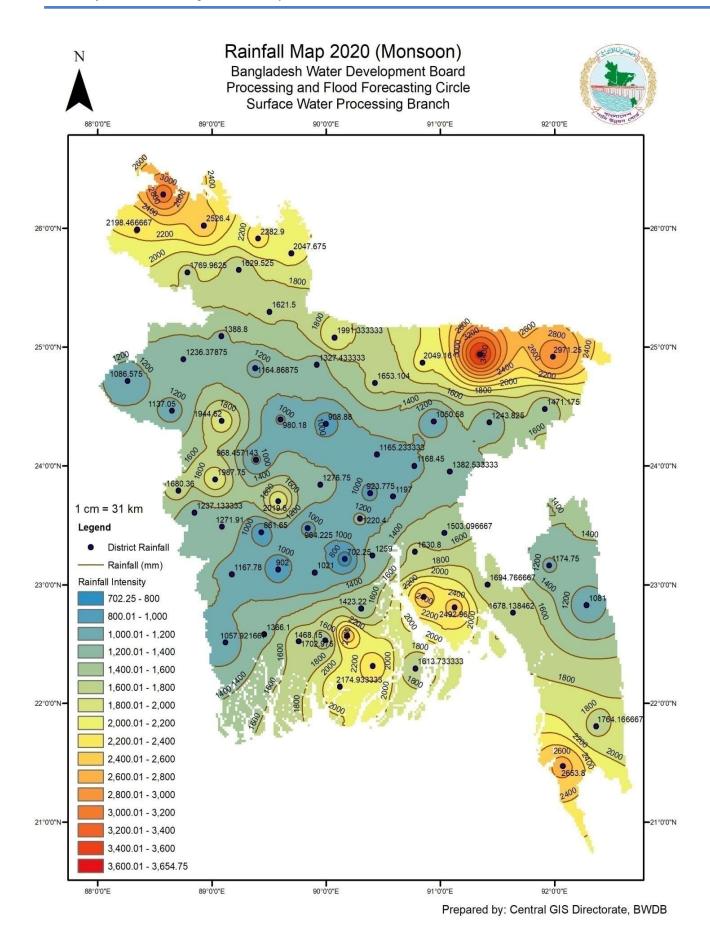


Figure 3.2(b): Rainfall map, Monsoon 2020 (average rainfall June, July, August, and September of 2020)

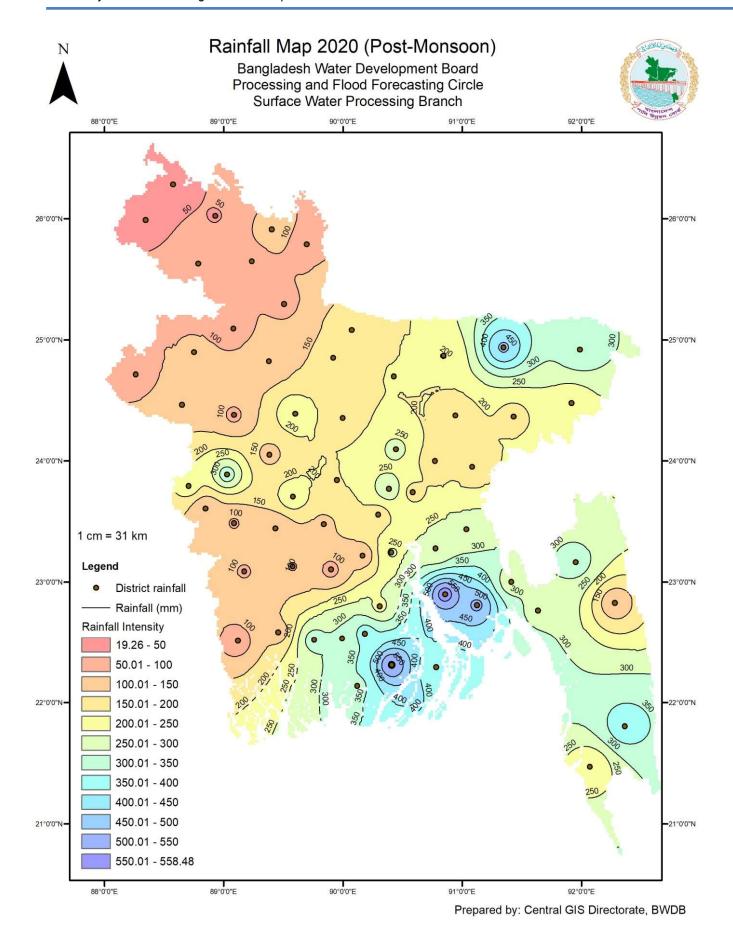


Figure 3.2(c): Rainfall map, Post Monsoon 2020 (Average rainfall October and November of 2020)

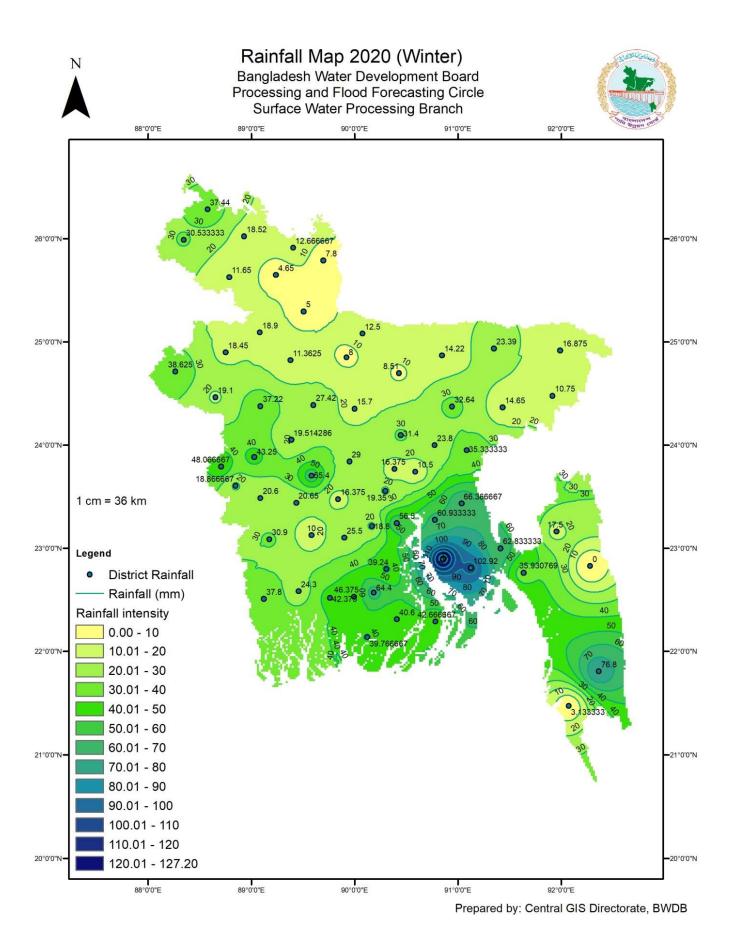


Figure 3.2(d): Rainfall map, Winter 2020 (average rainfall December, January and February of 2020)

Chapter 4 Findings and Discussions

4.1 Summary of Rainfall Resources:

From the observed data of all 274 rainfall stations all over Bangladesh, it is found that the minimum monthly rainfall occurred is 0 mm most of the days in January, December and a few days in February in 2019. Also, the minimum monthly rainfall occurred is 0 mm most of the days in November, December & February and a few days in January & March in 2020.

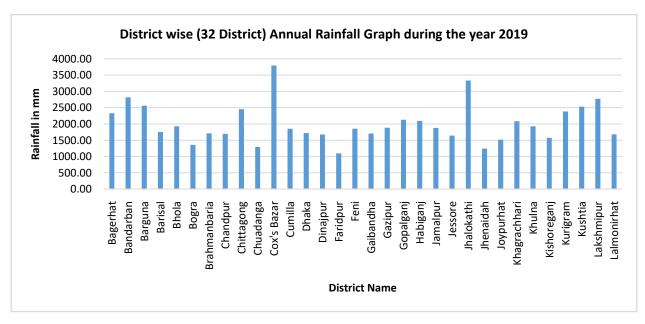


Figure 4.1a: District wise annual rainfall of 2019

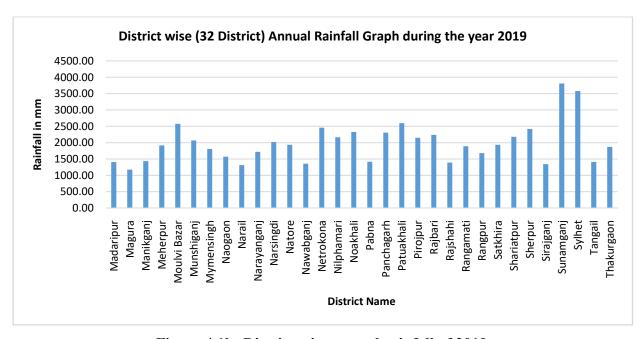


Figure 4.1b: District wise annual rainfall of 2019

The Station-wise Maximum monthly rainfall recorded is 1972.4 mm (Kutubdia, Coxsbazar, CL316) in July 2019 and 2210.9 mm (Tentulia, Panchagarh, CL220) in September 2020 respectively. The minimum yearly total rainfall is 130.6 mm & 220.7 mm in 2019 & 2020 respectively at Pirgacha, Rangpur, CL202. The Maximum yearly rainfall is 6060.50 mm (Sunamganj Sadar, Sunamganj, CL127) & 6550.00 mm (Gurudaspur, Natore, CL-14) in 2019 & 2020 respectively.

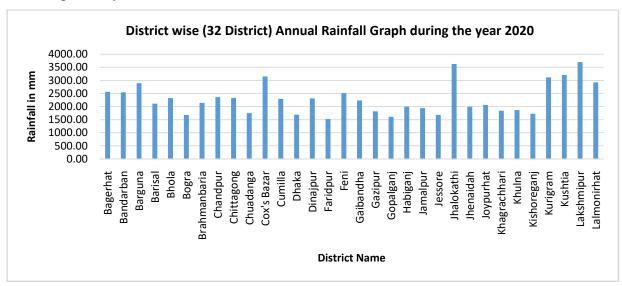


Figure 4.2a: District wise annual rainfall of 2020

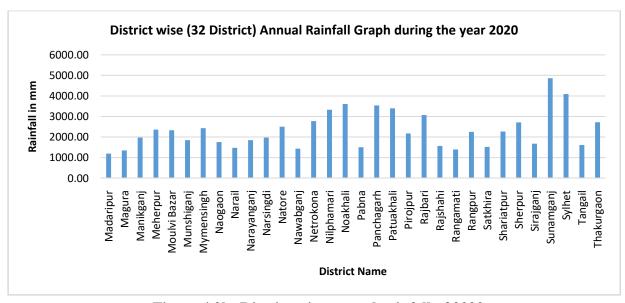


Figure 4.2b: District wise annual rainfall of 2020

After analysis of observed data, it is found that the Maximum yearly rainfall occurred is 3810.35 mm (Sunamganj district) and the minimum yearly rainfall is 1086.25 mm (Faridpur district) in 2019. The Maximum yearly rainfall is 4862.85 mm (Sunamganj district) and the minimum yearly rainfall is 1189.55 mm (Madaripur district) in 2020.

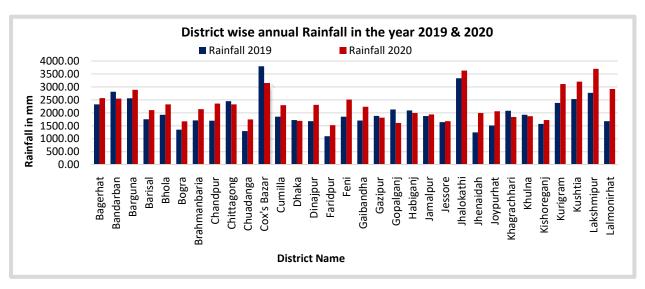


Figure 4.3a: District wise annual rainfall of 2019 and 2020

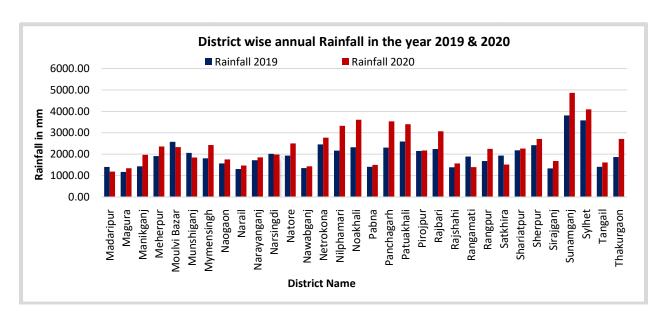


Figure 4.3b: District wise annual rainfall of 2019 and 2020

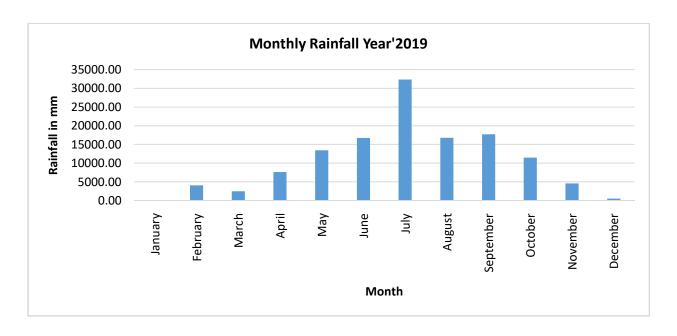


Figure 4.4: Monthly rainfall of 2019

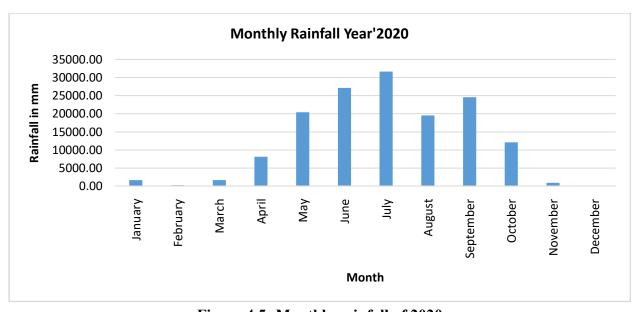


Figure 4.5: Monthly rainfall of 2020

The monthly total rainfall varies from 9.57 mm to 32095.08 mm, minimum rainfall occurred 9.57 mm in January and maximum rainfall is 32095.08 mm in July for 2019. In 2020 it varies from 5.29 mm to 31217.09 mm, minimum rainfall of 5.29 mm occurred in December and maximum rainfall is 31217.09 mm in July.

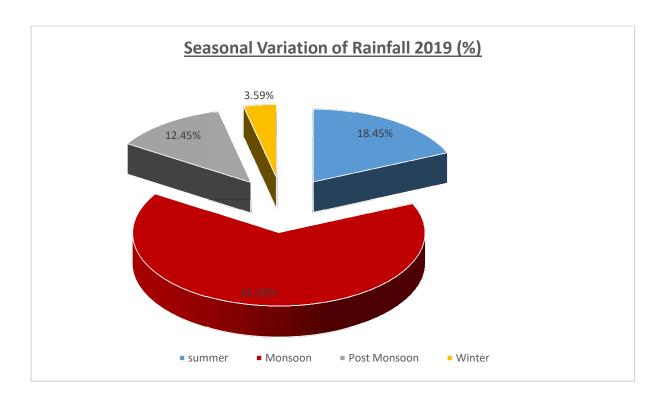


Figure 4.6: Seasonal variation rainfall of 2019

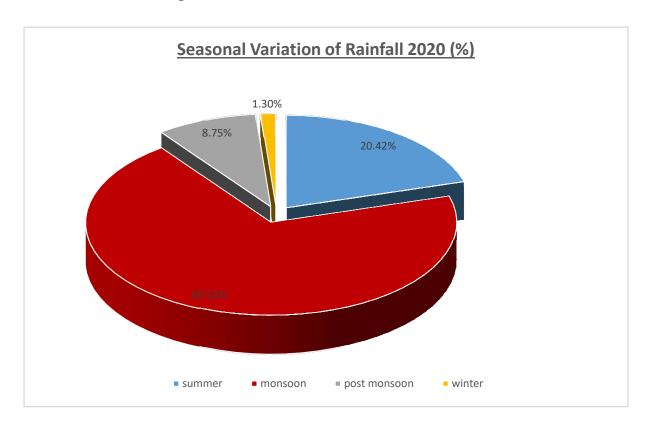


Figure 4.7: Seasonal variation rainfall of 2020

The average annual rainfall in 2019 is 1974.45mm, 65.50% of average rainfall occurred in monsoon (June to September) and in 2020 it is 2284.70mm, 69.52% of it occurred in monsoon.

4.2 Conclusion

The annual rainfall of Bangladesh has been analysed for 2019 and 2020 from BWDB recorded data. The rainfall volume was calculated as the product of annual average rainfall in the district area and presented in Million m³. It is found that the range of rainfall varies from 1086.25 mm to 3810.35 mm in 2019 and the average is 1974.45mm. During the year 2020, it varies from 1189.55 mm to 4862.85 mm and the average is 2284.70mm. The total volume of rainfall is 302725.93 Mm³ in 2019 and 342341.88 Mm³ in 2020. The total depth of rainfall is 2.048m and 2.316 m in 2019 and 2020 respectively. In this study, we also found that a maximum of 65.50% to 69.52% rainfall occurred during the monsoon (June to September) and a minimum of 1.30% to 3.59% rainfall occurred during the winter season (December, January, and February).

REFERENCES

BWDB Database, Wikipedia

APPENDIX

List of Rainfall Station Name and ID

List of Rainfall Station Name and ID						
SL No	District	Station Name	ID NO	Remarks		
01	Bagerhat	Bagerhat	CL501			
02	Bagerhat	Mollahhat	CL511			
03	Bagerhat	Morrelganj	CL512			
04	Bagerhat	Rampal	CL516			
05	Bandarban	Bandarban	CL303			
06	Bandarban	Lama	CL317			
07	Bandarban	Nakhyongochari	CL322			
80	Barguna	Bamna	CL253			
09	Barguna	Barguna	CL256			
10	Barguna	Patharghata	CL272			
11	Barisal	Bakerganj	CL252			
12	Barisal	Banaripara	CL254			
13	Barisal	Barisal	CL258			
14	Barisal	Gournadi	CL263			
15	Bhola	Borhanuddin	CL257			
16	Bhola	Bhola	CL260			
17	Bhola	Daulatkhan	CL261			
18	Bogura	Dhunot	CL11			
19	Bogura	Dubchanchia	CL169			
20	Bogura	Khetlal	CL181			
<u>20</u> 21	Bogura	Shibgani (Bogra)	CL216			
22	Bogura	Nandigram	CL22			
23	Bogura	Nawkhila	CL24			
24	Bogura	Sherpur_Bogra	CL33			
25	Bogura	Bogra	CL6			
26	Brahmanbaria	Brahmanbaria	CL103			
27	Brahmanbaria	Sarail	CL131			
28	Brahmanbaria	Nasirnagar	CL131			
29	Brahmanbaria	Bancharampur	CL351			
30	Brahmanbaria	Kasba	CL362			
31	Brahmanbaria		CL367			
32		Nabinagar Chandpur	CL354			
33	Chandpur	•	CL360			
<u>აა</u> 34	Chandpur	Hajiganj	<u> </u>			
35	Chandpur	Monoharpur	CL52 CL301			
36	Chattogram	Amtali				
	Chattogram	Anowara	CL302			
37	Chattogram	Chittagong	CL306			
38	Chattogram	Fatikchari	CL311			
39	Chattogram	Hathazari	CL313			
40	Chattogram	Mirsarai	CL320			
41	Chattogram	Narayanhat	CL323			
42	Chattogram	Nazirhat	CL324			
43	Chattogram	Patia	CL325			
44	Chattogram	Rangunia	CL330			
45	Chattogram	Sandwip	CL331			
46	Chattogram	Satkania	CL332			
47	Chattogram	Sitakunda	CL334			
48	Chuadanga	Amla	CL214			
49	Chuadanga	Chuadanga	CL224			
50	Chuadanga	Alamdanga	CL452			

SL No	District	Station Name	ID NO	Remarks
51	Coxs Bazar	Dulahazara	CL310	
52	Coxs Bazar	Teknaf	CL312	
53	Coxs Bazar	Kutubdia	CL316	
54	Cumilla	Barura	CL352	
55	Cumilla	Comilla	CL356	
56	Cumilla	Daudkandi	CL357	
57	Cumilla	Gunabati	CL359	
58	Cumilla	Laksam	CL363	
59	Cumilla	Muradnagar	CL366	
60	Cumilla	Elliotgani	CL50	
61	Cumilla	Chauddagram	CL51	
62	Cumilla	Barnaya	CL53	
63	Dhaka	Savar	CL31	
64	Dhaka	Nawabganj	CL412	
65	Dhaka	Dhaka Banani	CL42	
66	Dhaka	Dhaka_PBO	CL9	
67	Dinajpur	Ghoraghat	CL164	
68	Dinajpur	Dinajpur	CL168	
69	Dinajpur	Hilli (Hakimpur)	CL175	
70	Dinajpur	Khansama	CL179	
71	Dinajpur	Kantanagar	CL180	
72	Dinajpur	Nawabganj	CL196	
73	Dinajpur	Phulbari	CL201	
74	Dinajpur	Setabganj	CL213	
75	Faridpur	Bhanga	CL403	
76	Faridpur	Boalmari	CL404	
77	Faridpur	Faridpur	CL406	
78	Faridpur	Modhukhali	CL411	
79	Feni	Chhagalnaya	CL355	
80	Feni	Feni	CL358	
81	Feni	Parshuram	CL370	
82	Gaibandha	Gaibandha(Bhawaniganj)	CL156	
83	Gaibandha	Gobindaganj	CL171	
84	Gaibandha	Sundarganj	CL218	
85	Gazipur	Joydebpur	CL17	
86	Gazipur	Sreepur	CL37	
87	Gazipur	Maona	CL43	
88	Gopalganj	Fatehpur	CL407	
89	Gopalganj	Haridaspur	CL409	
90	Habiganj	Chandpur Bagan	CL105	
91	Habiganj	Habiganj	CL110	
92	Habiganj	Itakhola(Baikuntha)	CL111	
93	Habiganj	Markuli	CL120	
94	Jamalpur	Sarishabari	CL32	
95	Jamalpur	Dewanganj	CL62	
96	Jamalpur	Jamalpur	CL67	
97	Jessore	Rajghat	CL451	
98	Jessore	Benapole	CL453	
99	Jessore	Chaugacha	CL454	
100	Jessore	Jessore	CL456	
101	Jessore	Keshabpur	CL459	

SL No	District	Station Name	ID NO	Remarks
102	Jhalokathi	Jhalokati	CL264	
103	Jhenaidah	Dattanagar	CL455	
104	Jhenaidah	Jhenaidah	CL457	
105	Jhenaidah	Kaliganj (Jessore)	CL458	
106	Jhenaidah	Sailkupa	CL463	
107	Joypurhat	Joypurhat	CL520	
108	Khagrachhari	Manikchari	CL319	
109	Khagrachhari	Ramgarh	CL327	
110	Khulna	Chalna	CL503	
111	Khulna	Dumuria	CL504	
112	Khulna	Kapilmuni	CL509	
113	Khulna	Khulna	CL510	
114	Khulna	Paikgacha	CL515	
115	Kishoreganj	Bhairab Bazar	CL101	
116	Kishoreganj	Itna	CL112	
117	Kishoreganj	Khaliajuri	CL113	
118	Kishoreganj	Bajitpur	CL61	
119	Kishoreganj	Kishoreganj	CL71	
120	Kurigram	Bhurangamari	CL159	
121	Kurigram	Chilmari	CL163	
122	Kurigram	Kurigram	CL182	
123	Kurigram	Ulipur	CL222	
124	Kushtia	Kushtia	CL19	
125	Kushtia	Bheramara	CL19	
126	Kustia	Pragpur (Shikarpur)	CL217	
127	Lakshmipur	Lakshmipur	CL364	
128	Lakshmipur	Raipur (Noakhali)	CL304	
129	Lakshmipur	Ramgati	CL372	
130	Lakshmipur	Dattapara	CL573	
131	Lalmonirhat	Hatibandha	CL174	
132	Lalmonirhat	Lalmanirhat	CL174	
133			CL200	
134	Lalmonirhat	Patgram	CL200	
135	Madaripur	Madaripur	CL410	
136	Madaripur	Shibchar	1	
	Magura	Magura	CL460	
137 138	Magura Manikaani	Salikha	CL462	
	Manikgani	Daulatpur	CL10	
139	Manikganj	Manikganj Hogalbaria	CL20	
140	Meherpur		CL223	
141	Meherpur Moulvi Bozor	Meherpur	CL225	
142	Moulvi Bazar	Chandbagh	CL104	
143	Moulvi Bazar	Dakhinbagh	CL108	
144	Moulvi Bazar	Kamalganj	CL114	
145	Moulvi Bazar	Langla	CL117	
146	Moulvi Bazar	Monumukh	CL119	
147	Moulvi Bazar	Moulvi Bazar	CL122	
148	Moulvi Bazar	Srimangal	CL126	
149	Moulvi Bazar	Monu Rly. Br.	CL229	
150	Munshiganj	Munshiganj	CL365	
151	Munshiganj	Bhagyakul	CL402	
152	Mymensingh	Phulbaria	CL27	

SL No	District	Station Name	ID NO	Remarks
153	Mymensingh	Ghosegaon	CL45	
154	Mymensingh	Rasulpur	CL46	
155	Mymensingh	Bhaluka	CL5	
156	Mymensingh	Gafargaon	CL64	
157	Mymensingh	Gauripur	CL65	
158	Mymensingh	Muktagacha	CL72	
159	Mymensingh	Mymensingh	CL73	
160	Mymensingh	Nandail	CL75	
161	Mymensingh	Phulpur	CL77	
162	Naogaon	Badalgachi	CL152	
163	Naogaon	Manda	CL185	
164	Naogaon	Mohadebpur	CL187	
165	Naogaon	Naogaon	CL191	
166	Naogaon	Nazipur (Patnitala)	CL192	
167	Naogaon	Nithpur	CL194	
168	Naogaon	Sapahar	CL211	
169	Naogaon	Atrai Ahsanganj	CL3	
170	Narail	Narail	CL461	
171	Narayanganj	Shimrail	CL519	
172	Narsingdi	Narsindi	CL76	
173	Narsingdi	Shibpur	CL79	
174	Natore	Gurudaspur	CL14	
175	Natore	Joari	CL16	
176	Natore	Lalpur	CL184	
177	Natore	Natore	CL23	
178	Natore	Singra	CL36	
179	Nawabganj	Bholahat	CL158	
180	Nawabganj	Nachole	CL190	
181	Nawabganj	Chapai-Nawabganj	CL195	
182	Nawabganj	Rohanpur	CL208	
183	Netrokona	Kendua	CL115	
184	Netrokona	Mohanganj	CL121	
185	Netrokona	Netrokona	CL123	
186	Netrokona	Durgapur	CL63	
187	Netrokona	Jaria-jhanjail	CL68	
188	Nilphamari	Bagdogra(Nilphamari)	CL154	
189	Nilphamari	Dimla	CL167	
190	Nilphamari	Kaliganj	CL177	
191	Nilphamari	Saidpur	CL210	
192	Nilphamari	Dalia	CL226	
193	Noakhali	Basurhat	CL353	
194	Noakhali	Hatiya	CL361	
195	Noakhali	Noakhali	CL369	
196	Noakhali	Senbag	CL376	
197	Noakhali	Sonaimuri	CL377	
198	Pabna	Atghoria	CL1	
199	Pabna	Faridpur Banuaripara	CL12	
200	Pabna	Ishurdi	CL15	
201	Pabna	Pabna	CL25	
202	Pabna	Sujanagar	CL38	
203	Pabna	Bera	CL4	
204	Pabna	Chatmohar	CL7	

SL No	District	Station Name	ID NO	Remarks
205	Panchagarh	Bhithargarh	CL157	
206	Panchagarh	Boda	CL161	
207	Panchagarh	Debiganj	CL166	
208	Panchagarh	Panchagarh	CL197	
209	Panchagarh	Tentulia	CL220	
210	Patuakhali	Bauphal	CL255	
211	Patuakhali	Galachipa	CL262	
212	Patuakhali	Patuakhali	CL266	
213	Patuakhali	Khepupara	CL269	
214	Pirojpur	Bhandaria	CL259	
215	Pirojpur	Mathbaria	CL265	
216	Pirojpur	Pirojpur	CL267	
217	Pirojpur	Nazirpur	CL271	
218	Rajbari	Rajbari	CL30	
219	Rajshahi	Godagari	CL172	
220	Rajshahi	Puthia	CL204	
221	Rajshahi	Rajshahi	CL205	
222	Rajshahi	Sardah	CL212	
223	Rajshahi	Shibganj(Rajshahi)	CL215	
224	Rajshahi	Tanore	CL219	
225	Rangamati	Rangamati	CL328	
226	Rangpur	Latu	CL118	
227	Rangpur	Badarganj	CL153	
228	Rangpur	Kaunia	CL178	
229	Rangpur	Mithapukur	CL186	
230	Rangpur	Mahipur	CL188	
231	Rangpur	Pirgacha	CL202	
232	Rangpur	Pirgani	CL203	
233	Rangpur	Rangpur	CL206	
234	Satkhira	Benarpota	CL502	
235	Satkhira	Islamkati	CL505	
236	Satkhira	Kaikhali	CL506	
237	Satkhira	Kalaroa	CL507	
238	Satkhira	Kaliganj(Khulna)	CL508	
239	Satkhira	Satkhira	CL518	
240	Shariatpur	Palong	CL413	
241	Sherpur	Nakuagaon	CL227	
242	Sherpur	Nalitabari	CL74	
243	Sherpur	Sherpur Town	CL78	
244	Sirajganj	Raiganj	CL29	
245	Sirajganj	Sirajganj	CL34	
246	Sirajganj	Shazadpur	CL35	
247	Sirajganj	Taras	CL39	
248	Sirajganj	Ullapara	CL40	
249	Sunamganj	Durlavpur	CL106	
250	Sunamganj	Chhatak	CL107	
251	Sunamganj	Gobindaganj	CL109	
252	Sunamganj	Sunamganj	CL127	
253	Sunamganj	Moheshkhola	CL44	
254	Sunamganj	Laurergarh	CL49	
255	Sunamganj	Taherpur	CL526	

SL No	District	Station Name	ID NO	Remarks
256	Sunamganj	Madhanagar	CL527	
257	Sunamganj	Derai	CL528	
258	Sunamganj	Shulla	CL529	
259	Sylhet	Companyganj Bholaganj	CL102	
260	Sylhet	Lallakhal	CL116	
261	Sylhet	Sheola	CL125	
262	Sylhet	Sylhet	CL128	
263	Sylhet	Tajpur	CL129	
264	Sylhet	Zakiganj	CL130	
265	Sylhet	Kanairghat	CL228	
266	Sylhet	Jaflong	CL48	
267	Tangail	Gopalpur	CL13	
268	Tangail	Kalihati	CL18	
269	Tangail	Tangail_Atia	CL2	
270	Tangail	Mirzapur	CL21	
271	Tangail	Kutubpur	CL47	
272	Thakurgaon	Nekmard	CL193	
273	Thakurgaon	Ruhea	CL209	
274	Thakurgaon	Thakurgaon	CL221	