

## **Climate Change Impact: Climate Type, Vegetation Type, Rainfall Intensity Over Three Decades in Bangladesh**

Md. Tanvir Alam<sup>1</sup>, Syeed Md. Iskander<sup>2</sup>

<sup>1</sup>(Department of Civil Engineering, Ahsanullah University of Science & Technology (AUST), Bangladesh)

<sup>2</sup>(Lecturer, Department of Civil Engineering, Ahsanullah University of Science & Technology (AUST), Bangladesh)

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**Abstract:** Erinc, 's aridity index (Precipitation Efficiency,  $I_m$ ) was used to find out the Climate type and Vegetation type for Bangladesh. This index was applied to 27 meteorological stations of Bangladesh for the study period of 1971 to 2000. According to it Bangladesh is under Very Humid climate type and Very Humid forest type vegetation. But some of the part of North Western and South Western region is under humid climate type and humid forest type vegetation. Mean Rainfall Intensity (MRI) shows positive change for South Eastern region and little part of North Western region for the study period.

**Keywords:** Bangladesh, Climate Change, Very Humid Climate, Precipitation, Aridity Index.

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### **I. Introduction**

According to the intergovernmental Panel on Climate Change [1], global mean surface temperatures have increased by 0.74% since the late nineteenth century. This means changing in present climate. Similar variety appeared also in 1990 and 1991, which has been accepted as the two warmest year of global record [2].

Global temperature anomalies were smaller in 1992 and 1993 than peak value reached in 1990 [3]. Rainfall is changing due to global warming on both the global [4,5,6] and the regional scales [7,8,9]. Future climate changes may involve modifications in climatic variability as well as changes in averages [10]. Climate Changes usually have strong effect on the people and their behavior as well as on agriculture resources and the availability of water, and especially is important in regions where economic activity is dependent on agriculture [11]. The purpose of this study is to show changes in rainfall intensity, trend in rainfall intensity, climate type, vegetation type, and the effects on the climate of Bangladesh by examining descriptive statistical features of annual rainfall totals, rainfall intensity and annual maximum temperature. However, in our study, essential information on the rainfall and temperature climatology of this region are given by examining descriptive statistical features of annual rainfall totals, decreasing and increasing patterns in these climatic parameters.

### **II. Location**

The study area is Bangladesh. Its position is between latitude 20° 34' - 26° 38' N, longitude 88° 01' - 92° 41' E. For the convenience of analysis the study is based on available data of 27 BMD (Bangladesh Meteorological Department) stations among 34 BMD stations. The available rainfall data are daily and monthly rainfall record of 27 BMD stations for 30 years (1971-2000). The available temperature data is monthly maximum temperature for 30 years (1971-2000) of 27 BMD stations.

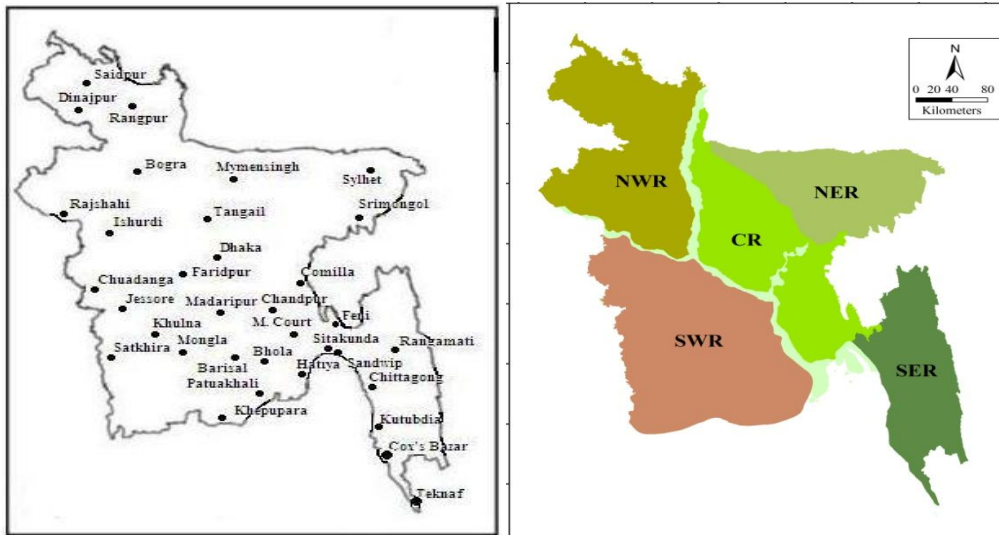


Figure 1: BMD stations and Regions of Bangladesh

### III. Methodology

Climate indices for 27 meteorological station of Bangladesh for the period of 1971-2000 were determined using Erinc, 's aridity index (precipitation efficiency,  $I_m$ ) [12] which is based on the precipitation and the maximum temperature that causes the water deficiency by evaporation.  $I_m$  is defined as follows

$$I_m = \frac{P}{T_{max}} \dots\dots\dots (1)$$

Where, P and  $T_{max}$  equal to the long term average of the annual precipitation total (mm) and of annual maximum temperature ( $^{\circ}C$ ).

The total period (1971-2000) was divided into two sub periods; 1971-1986 and 1987-2000. According to Erol [13], rainfall intensity at stations was calculated as the ratio between total amount of rain water and duration of the rainfall. The basic equation of  $R_i$  is defined as follows

$$R_i = \frac{Ar}{Rd} \dots\dots\dots (2)$$

Where,  $R_i$  (mm/day) is rainfall intensity, Ar is total amount of rain water (mm) and, Rd is duration of the rainfall as day.

Table 1: Erinc, 's climate types corresponding to the aridity index ( $I_m$ ) and vegetation types (Erinc, 1965)

Index( $I_m$ )	Climate Type	Vegetation Type
<8	Absolute arid	Desert
8-15	Arid	Desert-like steppe
15-23	Semi arid	Steppe
23-40	Semi humid	Park-like appearance dry forest
40-55	Humid	Humid forest
>55	Very humid	Very humid forest

### IV. Result and Discussion

The climate and vegetation types were determined using Erinc, 's aridity index (Table 2). According to this index, climate of Bangladesh ranges from humid to very humid type. While the vegetation type ranges from humid forest to very humid forest. In parts of North Western Region (NWR) and South Western Region (SWR) climate type is humid in both periods. In the rest of the country climate is very humid. Only in Faridpur climate type and vegetation type changes within the periods. As shown in (Table 3) decrease and increase in MRI are evident in the study area. Decrease in MRI was found in 18 stations. The percentage decrease ranged between 0.63% to 28.33%. Decrease is significant in Faridpur, Madaripur, Ishurdi, Khulna, Bhola, Potuakhali, Chandpur, Hatya, M. Court and Sandwip. Although a decrease in MRI is not significant in some stations, such as Rangpur, Jessore, Barisal, Khepupara. Increase in MRI was observed in 9 stations. They are Dhaka, Sylhet, Bogra, Dinajpur, Satkhira, Chittagong, Cox's Bazar, Kutubdia, Rangamati. The percentage increase ranges between 0.52 % to 9.83 %. The stations with significant increase are Kutubdia, Chittagong. Trends in intensity are same as change ratio. Where there is increase of MRI between periods; trends found as increasing for the whole period and vice versa.

**Table 2: Climate and vegetation types, according to Erinc, 's aridity index, of the stations for the periods 1971-1986 and 1987-2000. Bold rows shows areas where the Erinc, 's climate and vegetation category has changed.**

Station	1971-1986 Index/Climate type/Vegetation	1987-2000 type/Vegetation	Index/Climate
Dhaka	63.58/very humid/very humid forest	59.86/very humid/very humid forest	
Mymensingh	67.93/very humid/very humid forest	71.91/very humid/very humid forest	
<b>Faridpur</b>	<b>56.91/very humid/very humid forest</b>	<b>52.72/ humid/humid forest</b>	
Madaripur	63.88/very humid/very humid forest	57.30/very humid/very humid forest	
Srimangal	63.61/very humid/very humid forest	67.97/very humid/very humid forest	
Sylhet	122.59/very humid/very humid forest	132.57/very humid/very humid forest	
Bogra	50.72/ humid/ humid forest	53.58/ humid/ humid forest	
Dinajpur	56.90/very humid/very humid forest	60.78/very humid/very humid forest	
Ishurdi	49.21/ humid/ humid forest	42.45/ humid/ humid forest	
Rajshahi	44.11/humid/humid forest	42.09/ humid/ humid forest	
Rangpur	63.67/very humid/very humid forest	68.29/very humid/very humid forest	
Jessore	44.57/ humid/ humid forest	44.45/ humid/ humid forest	
khulna	54.69/ humid/ humid forest	48.89/ humid/ humid forest	
Satkhira	46.20/ humid/ humid forest	48.37/ humid/ humid forest	
Barisal	62.73/very humid/very humid forest	62.11/very humid/very humid forest	
Bhola	76.80/very humid/very humid forest	66.34/very humid/very humid forest	
Khepupara	74.50/very humid/very humid forest	86.30/very humid/very humid forest	
Potua khali	78.46/very humid/very humid forest	77.61/very humid/very humid forest	
Chandpur	86.73/very humid/very humid forest	58.65/very humid/very humid forest	
Chittagong	85.47/very humid/very humid forest	89.97/very humid/very humid forest	
Comilla	59.92/very humid/very humid forest	63.41/very humid/very humid forest	
Coxs Bazar	106.43/very humid/very humid forest	116.14/very humid/very humid forest	
Hatya	93.46/very humid/very humid forest	88.27/very humid/very humid forest	
Kutubdia	75.13/very humid/very humid forest	98.62/very humid/very humid forest	
M.court	95.91/very humid/very humid forest	91.48/very humid/very humid forest	
Rangamati	68.28/very humid/very humid forest	81.81/very humid/very humid forest	
Sandwip	109.93/very humid/very humid forest	104.56/very humid/very humid forest	

**Table 3: Mean rainfall intensity (MRI) and trend in rainfall intensity of BMD stations for the study periods 1971-1986 and 1987-2000.**

Station	MRI (1971-1986)	MRI (1987-2000)	Decrease ratio%	Increase ratio %	Trend in rainfall intensity
Dhaka	17.31	17.4		0.52	0.021
Mymensingh	19.74	18.23	7.65		-0.113
Faridpur	18.29	15.91	<b>13.01</b>		-0.125
Madaripur	20.03	16.65	<b>16.87</b>		-0.111
Srimangal	18.24	16.87	7.51		-0.063
Sylhet	25.56	25.93		1.45	-0.02
Bogra	16.64	17.15		3.06	0.007
Dinajpur	20.12	20.94		4.08	0.003
Ishurdi	18.29	15.13	<b>17.28</b>		-0.237
Rajshahi	16.56	15.11	8.76		-0.103
Rangpur	20.64	20.51	0.63		0.086
Jessore	15.43	15.13	1.95		-0.019
Khulna	17.18	14.91	<b>13.21</b>		-0.187
Satkhira	15.02	15.3		1.86	0.007
Barisal	17.8	17.12	3.82		-0.038
Bhola	20.81	17.65	<b>15.19</b>		-0.179
Khepupara	22.78	22.43	1.54		-0.057
Potua khali	24.98	19.93	<b>20.22</b>		-0.315
Chandpur	23.93	17.15	<b>28.33</b>		-0.413
Chittagong	23.81	25.62		7.6	0.184
Comilla	18.92	17.61	6.92		-0.007
Coxs Bazar	28.16	28.97		2.88	0.006
Hatya	24.75	22.16	<b>10.46</b>		-0.111
Kutubdia	25.94	28.49		9.83	<b>0.269</b>
M.court	31.88	22.97	<b>27.95</b>		<b>-0.445</b>
Rangamati	20.01	20.23		1.1	0.076
Sandwip	31.84	27.99	<b>12.09</b>		-0.253

## V. Conclusion

Temperatures and rainfall amounts between 1971 and 2000 allowed us to visualize and evaluate climate changes on annual scale. Very humid climate and very humid forest type vegetation prevailed in Faridpur between 1971 and 1986. However, humid and humid forest type prevailed between 1987-2000. In Rajshahi and Ishurdi humid climate types were prevailed between 1971-1986. Now they are on the run of being semi-humid. A massive change has been noticed in Chandpur, it is changing from very humid type to humid type climate. Decrease in MRI was found in 18 stations. The percentage decrease ranged between 0.63% to 28.33%. Decrease is significant in Faridpur (13.01%), Madaripur (16.87%), Ishurdi (17.28%), Khulna (13.21%), Bhola (15.19%), Potuakhali (20.22%), Chandpur (28.33%), Hatya (10.46%), M.Court (27.95%) and Sandwip (12.09%). Increase in MRI were observed in 9 stations. The stations with significant increase are Kutubdia(9.83%) and Chittagong(7.6%).

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